Rugby. Finding that natural science had no place in the teaching at Rugby, he urged its introduction on Dr. Tait. The latter was quite willing to make the experiment, provided Dr. Sharp would become the first teacher, and, under the style of "Reader in Natural Philosophy," Dr. Sharp conducted the classes during 1849 and 1850. "If," said the late Tom Hughes, "Tait had done nothing else at Rugby than appointing Sharp, not without difficulty, as reader in Natural Philosophy, he would have deserved the gratitude of every Rugby man." Dr. Sharp was also one of the early supporters of the establishment of local museums, and read a paper on the subject before the British Association in 1839. His more important writings were on the various schools of medicine, and appeared at intervals under the title of "Essays in Medicine." He was elected a Fellow of the Royal and of the Geological Society in 1840.

ARTHUR SIDNEY OLLIFF,

BORN AT MILLBROOK, HANTS, OCTOBER 21, 1865.

DIED AT SYDNEY, N.S.W., DECEMBER 29, 1895.

WE deeply regret to learn of the premature death of this energetic worker and charming man. He early displayed a liking for entomology, and, when a boy, assisted Mr. C. O. Waterhouse at the British Museum. From 1883 to 1885 he was private secretary and scientific assistant to Lord Walsingham. In February, 1895, he joined the Australian Museum as assistant zoologist, and remained there until transferred to the Department of Agriculture in 1890. His published writings are chiefly on Coleoptera, and to a less extent on Lepidoptera. Of late years his contributions to economic entomology have had much practical value.

THE death in Havana of JOHN GUNDLACH is announced by *Science*. He was born at Marburg, Hesse-Cassell, in 1810, and went to Cuba in 1839 on the invitation of the wealthy Cuban, Mr. Booth. His collection of the fauna is preserved in the Institute at Havana. He was the author of a work on Cuban ornithology, and of a book on the fauna of both the Antilles.

THE death is announced in Paris of Professor MARIE PHILIBERT CONSTANT SAPPEY, at the advanced age of 86. Though chiefly devoted to medical subjects, he is well-known by several contributions to anatomy and histology. His first paper, published in the *Comptes Rendus* for 1846, is a preliminary account of his volume on the respiratory apparatus of birds issued during the following year in Paris. In 1880 he published a second separate work on the slime-canal and lymphatic systems of fishes.

WE regret to learn from Professor Mitsukuri of the death of Dr. S. HIROTA, who was a worker of great promise. It is not long since we received from him some anatomical notes on the "Comet" of *Linckia multifora*, from the *Zoological Magazine*, of Tokyo, in which he had also published papers on the fauna of the Ogasawara (Bonin) Islands, on the loss of weight in the fowl's egg during incubation, and on a skink with an accessory tail. In the *Journal of the College of Science*, Tokyo, he had published a paper on the sero-amniotic connection and the fœtal membranes in the chick, while the last number of that Journal contains a contribution by him on the dendritic appendage of the urogenital papilla of a siluroid, in which he comes to the conclusion that the organ in question is a highly specialised gland early developed in both sexes.

WE have also to record the deaths of: MARMADUKE LAWSON, Director of the Government Chinchona Plantations in the Neilgherries, who was Sherardian Professor of Botany and Sibthorpian Professor of Rural Economy at Oxford from 1868 to 1883, at Madras on February 14; ABEL HOVELACQUE, Director of the École d'Anthropologie de Paris; on February 10, G. WAGENER, Professor of Anatomy of Marburg University, aged 74; Lieutenant EWIND ASTRUP, a well-known Polar explorer, and participator in both Peary's Greenland expeditions, who disappeared shortly before Christmas and whose body was found in the Dovrefjeld, in Norway, on January 21 by a search party; OTTO EHLERS, the German explorer, who started from Bayern Bay, intending to reach British New Guinea, but was drowned in the Heath River; Dr. L. JACOBY, ichthyologist, of Zürich; Professor K. RATHLEF, botanist; the ornithologist, H. TH. WHARTON, at the age of 50; Lieutenant H. E. BARNES, well-known for his works relating to Asiatic ornithology, aged 48; J. v. BERGENSTAMM, the noted dipterologist, in Vienna; Dr. A. SCHADENBERG, in Manilla, well-known for his researches on the flora and ethnography of the Philippines; JEAN MÜLLER (Argoniensis), the director of the Botanical Gardens at Geneva, Custodian of the Delessert Herbarium, and a leading authority on lichens, at the age of 68, on January 28; Dr. F. SANSONI, Professor of Mineralogy in Pavia, and editor of the Italian Journal of Mineralogy; ROBERT HAY, of the U.S. Department of Agriculture, and author of many papers on Kansas geology, at his home in Junction City, Kansas, on December 14, 1895; ALFRED L. KENNEDY, metallurgist and geologist, who, in 1852, founded the Polytechnic College of Philadelphia, burnt to death in his rooms at Philadelphia, on January 30, being in his 80th year. T. H. BUFFHAM, to whom algologists owe many interesting notes on the reproduction of seaweeds, died on February 9, aged 56.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced;—Mr. E. H. Cunningham-Craig, B.A., of Clare College, Cambridge, to be Assistant Geologist on the Geological Survey of Scotland; Professor D. Barfurth, of Dorpat, to be Professor of Anatomy at Rostock; Dr. Smirnow, of Kasan, to be Professor of Histology in Tomsk; H. Ph. von Norbeck, to be Chief Geologist of the Geological Survey in Vienna; Professor G. F. Atkinson, to be full Professor and Head of the Department of Botany (in succession to Professor Prentiss), E. J. Durand, to be Instructor, and K. M. Wiegand, to be Assistant in Botany, at Cornell University; H. C. Warren, to be Assistant Professor of Experimental Psychology in Princeton University.

THE Professor of Botany in Amsterdam, G. A. J. A. Oudemans, has resigned his appointment on the ground of old age.

THE French Academy of Medicine has awarded the Prix St. Paul, valued at £1,000, to Dr. Roux, of the Pasteur Institute, and Dr. Behring, of Berlin, for their joint discovery of the croup vaccine. The Academy thus gives official recognition to the claims of the German to be co-discoverer.

PROFESSOR K. A. VON ZITTEL has received the Hayden Medal of the Philadelphia Academy of Natural Science.

THE University of Glasgow has conferred the degree of LL.D. *honoris causa* on Mr. W. T. Thiselton Dyer, whom local papers describe as "of some standing among horticulturists," but otherwise unknown to fame. The University of Edinburgh has conferred the honorary degree of LL.D. upon Professor Edouard van Beneden, of Liège.

THE *Psychological Review* states that a laboratory of experimental psychology has been fitted up at the University of Kansas under the charge of Olin Temple, Professor of Philosophy.

PROFESSOR E. HERING, the successor of Ludwig at Leipzig, is lecturing on the "Physiology of Sensations and Movements." His addresses on "Heredity as a Form of Memory" and "The Specific Energies of the Nervous System" have recently been published as no. 16 of the Religion of Science Library by the Open Court Publishing Company, of Chicago, price 15c.

A NUMBER of scholarships and fellowships for graduates have been established at the University of Pennsylvania by means of a fund of $500,000 left to the University last June by Provost Harrison. "The whole plan," says *Science*, where full details will be found (vol. iii., p. 513), "aims at building up a cultured group of men interested in the advancement of knowledge and who shall be in residence at the University."

THE Department of Botany of Chicago University has planned a large building, to be known as the Hull Botanical Laboratory. "The four stories," says the *Botanical Gazette*, "will contain ample space for lecture-rooms, libraries, laboratories, and private research rooms for morphology, physiology, and taxonomy. A large roof greenhouse will supply an abundance of living material under all conditions."

WE learn from *Science* that Harvard University has, mainly by means of a fund established in 1892 by G. A. Gardner, of Boston, purchased several thousand photographs of geological and geographical subjects.

THE Sunday opening of the National Museums in London was inaugurated on Easter Day by the admission of the public to the various galleries of the South Kensington Museum, and to the Bethnal Green Museum, between the hours of 2 and 6. The total number of visitors to the South Kensington Museum was 7,168, which, however, is probably to be reduced owing to some visitors having passed through the numerous turnstiles more than once. At Bethnal Green the number was 3,026. It was odd to see in the picture galleries at South Kensington several pictures carefully hidden from view by cloths. A young lady visitor was overheard supposing that they were "too improper to be shown on a Sunday"; but we understand the truth to be that the terms of the Ellison bequest, under which they were left to the Museum, forbade their exhibition on the Sabbath. These pictures will therefore continue to be sealed treasures for the majority of Londoners.

THE Horniman Museum at Forest Hill has been open on Sunday afternoons ever since June 1, 1895, and up to Easter Day the visitors numbered 17,330, or an average of 391. The average for week-days, from 2.0 to 9 p.m., is 456. The present building is becoming so crowded with collections, especially of objects from the East, collected by Mr. Horniman during his recent travels, that it is intended to build a new museum. The Report for 1895, which has been sent to us, contains full-page illustrations of some recent acquisitions, of which the most interesting to our readers is, perhaps, the ancient Celtic bell of quadrangular shape, formed of a single plate of iron about 22 inches in length by 10 inches in breadth, which has been bent on itself in the middle, and riveted along the sides with flat-headed nails. The bell appears to have been dipped into melted bronze. It was found at Bosbury, in Herefordshire, and is of a type very rare in England. This museum has recently purchased a fine specimen of *Ichthyosaurus*, from the Lias of Keynsham, about ten feet in length.

A LARGE and beautiful series of original drawings of Fungi, by Mr. Edwin Wheeler, of Bristol, has recently been presented to the Trustees of the British Museum. The evanescent nature of many of the forms renders such faithful representation of the living and growing plants peculiarly valuable. Mr. Wheeler has laid all lovers of nature under special obligation to him for his splendid work, admirable alike for the scientific exactness of form and colour, and for the artistic rendering of these little-known plants. The larger forms, such as *Agaricus*, *Polyporus*, and *Boletus*, are the most fully represented. The Discomycetes, such as *Helvella*, *Peziza*, and others, are also included in the subjects of Mr. Wheeler's art. Many of the microscopic rusts, moulds, Mycetozoa, etc., which are so exquisite in detail, have been drawn by the aid of the microscope or the magnifying glass. They show us anew how much is visible to the trained eye that is entirely lost to the casual observer. Mr. Wheeler and his brother, Dr. Henry Wheeler, have handed over, as a free gift to the nation, this magnificent and unique collection of some 2,500 drawings. A selection from them is at present on exhibition in the Botanical Gallery of the Natural History Museum, Cromwell Road.

WE are glad to see that the inhabitants of Bristol take so much interest in their museum that Mr. E. Wilson's excellent little penny guide has gone into its sixth

edition. Among recent improvements in this museum is the formation of a students' geological collection, comprising between 600 and 700 specimens of fossils, rocks, and minerals, intended for the use of students studying geology for examinations. A catalogue of the collection, printed on one side the page, has been issued at the price of sixpence. The nomenclature of the catalogue follows that of accepted text-books.

THE Boston *Transcript*, as quoted in *Science*, announces that Mr. Charles B. Cary, Curator of the Ornithological Department of the Field Columbian Museum, has established at Palm Beach, Florida, a museum devoted to the natural history of the State, which is soon to be opened to the public. An excellent collection of birds, reptiles, mammals, fishes, etc., is already in order, and aquaria are to be fitted up for the study of salt- and fresh-water fishes.

FROM the *Botanical Gazette* we learn that the New York Botanic Garden has purchased the collections and part of the mycological library of Mr. J. B. Ellis, of Newfield, N.J. The herbarium contains numbers of type-specimens of fungi. It will be housed in the Museum now building at the Garden.

THE National Museum at Washington is to erect an additional fire-proof building.

AN International Congress of Miners and Geologists will be held at Buda-Pesth during the Hungarian Millennial Exhibition, on September 25 and 26 next.

THE *Irish Naturalist* announces the summer excursion programme of the Dublin Field Club, namely:—April 25, Bray and Killiney (geological half-day); May 30, Lambay Island; June 20, Bective and the Boyne; July 10, 11, and 13, Cavan; August 12, Kelly's Glen (half-day); September 5, Brittas Bay, co. Wicklow; September 20, Woodlands (fungus foray, half-day). The excursion to Cavan, when three days will be spent exploring the many lakes, rivers, and woods of that beautiful county, should prove especially productive, as the district is one almost unworked by the naturalist.

A SOCIETY has been formed at Ipswich for the protection of wild birds and their eggs in Suffolk. Portions of the Suffolk coast are under the protection of a Home Office order prohibiting the taking or destroying of eggs, in accordance with the Protection Acts. The work which the new society has set itself to do is to secure the protection of the whole area, and to appoint watchers to secure the enforcement of the existing order.

THE Technical Instruction Committee of the Essex County Council proposes to give a special course of instruction in marine zoology at the Biological Station of Brightlingsea during the summer months. The course is intended for students, and is the outcome of the lectures and practical instruction given at Brightlingsea during the past winter. The students of the botanical classes held at Chelmsford Laboratory are organising some field meetings for May, June, and July.

MR. A. A. CAMPBELL SWINTON has opened a special laboratory for the medical application of radiography or skiagraphy at his address, 66 Victoria Street, London, S.W.

WHILE regretting the sad loss of life that occurred at the opening of the Snowdon railway, lovers of nature cannot regard the accident to the train in the light of an unmixed evil, especially if it does anything to check the desecration of the few remaining spots of wild nature that still remain to us.

A SYNDICATE has been formed to mine coal near Dover, where, it will be remembered, Coal Measures have been proved to lie at about 12,000 feet below the surface. The syndicate has been buying up land in the neighbourhood for some time, and has acquired mining rights over some 5,000 acres. It is intended to begin work next June in Alkham Valley, three miles west of Dover.

THE State of Maryland has established a Geological and Economic Survey which will prepare and publish reports and maps. An annual appropriation of $10,000 has been made, and Professor W. B. Clark has been appointed State Geologist. Professor Clark's well-known energy and the amount of good work that he has already done in Maryland lead us to hope for great things from this new survey.

ACCORDING to the *Scottish Geographical Magazine*, Mr. Ad. de Gerlache, of the Belgian Navy, intends to start at the end of next summer for the Antarctic Regions in a steamship of 400 tons. He will pass two seasons in the Southern Ocean; in the first he will steer for the lands situated to the south of Cape Horn, and in the second will make for Victoria Land, principally to ascertain more exactly the position of the southern Magnetic Pole. The expedition will include specialists in meteorology, magnetism, oceanography, zoology, and botany, and will be provided with a complete set of instruments. Subscriptions to the sum of £10,000 are invited by the Royal Belgian Society of Geography.

Meanwhile, Mr. Borchgrevink, of whom we have heard so much of late, is, as we hinted in our February number, to join a whaling expedition to Victoria Land, which starts on September 1. For £5,000 he and eleven other naturalists will be taken out and landed at or near Cape Adare. They will work towards the South Magnetic Pole, taking magnetic, meteorological, and pendulum observations, surveying, and making collections. At present Mr. Borchgrevink has transferred his propagandism to the United States, and whether it be as the result of his endeavours or no, the American Society of Naturalists has appointed a committee of three to take measures for the fitting out of an Antarctic expedition in the near future. Its natural object would be the exploration of Graham's Land, which lies due south of Patagonia.

IN connection with Andrée's balloon-expedition to the North Pole, it is hoped to send a zoological expedition, under the direction of G. Grönberg, lecturer at Stockholm University, to the Norsk-öar, near Spitzbergen, from which islands the ascent is to be made. These islands have long been known as one of the richest zoological localities in this region. A Polish contingent to the expedition is being planned by Dr. Roszkowski and Prince O. Hajdukievicz, who are both studying at Stockholm. If thirty volunteers come forward, it is proposed to hire a steamer to accompany the "Virgo," which leaves Gothenburg with Andrée on May 1. After visiting Spitzbergen and the Norsk-öar, this steamer will return to the north of Norway to observe the solar eclipse. The Russian Government has distributed among the northern tribes under its rule several thousand copies of a pamphlet, in many languages, containing a picture of the balloon and the Czar's orders to all and sundry to assist the aëronauts. Mr. Andrée's balloon is being fitted with a complete instantaneous photographic apparatus which improves upon the Kodak, since by pressing the button, not merely is the view taken, but the day, hour, minute, and second are recorded. It is also intended to take several carrier pigeons, which will be dispatched from time to time.

ANOTHER expedition to Spitzbergen is that projected by Sir William Martin Conway, whose intention is to penetrate inland and explore many parts as yet unvisited. The expedition was to have started in May, but we understand that the time of its departure has been postponed till June, in the hope that Dr. J. W. Gregory, of the British Museum, may be able to accompany it. There are fossils of almost all geological periods, from the Devonian to the Pleistocene, to be obtained at Spitz-

bergen, but they are at present most meagrely represented in the national collections, so that there is plenty of work for a practised geologist. Dr. Gregory's book on his experiences in East Africa is on the point of publication, and he doubtless longs for "fresh fields and pastures new," if such a quotation can be applied to so inhospitable an island.

An exhibition at the Grafton Galleries, London, W., is very timely. This is a series of four pictures by the Arctic explorer, Professor Julius von Payer, representing the loss of the Franklin Expedition. As a representation of Arctic conditions by a skilled painter having practical experience thereof, as well as by virtue of their pathetic subject, the pictures are worth the attention of naturalists.

The "Faraday" has returned from the Amazons, bringing with her Messrs. Austen and Pickard Cambridge, who have amassed a fine collection, chiefly of Arthropoda, and including several spiders' nests. These will go to the British Museum (Natural History). Some interesting bionomic observations have been made.

Professor Alexander Agassiz, accompanied by Dr. W. McM. Woodworth and Dr. A. G. Mayer, has gone to Australia in order to investigate the Great Barrier Reef, for which purpose a special steamer has been chartered in Australia. He expects to return about July 1. Owing to his absence, Wachsmuth and Springer's Monograph of Crinoidea Camerata of N. America will not be published before August.

Science informs us that Mr. J. B. Hatcher, of Princeton College, special agent and collector for the Bureau of Ethnology at Washington, and Mr. O. A. Peterson, collector for the American Museum of Natural History, New York, have embarked for Patagonia on the steamship "Galileo."

Dr. K. Lauterbach, Mr. Tappenbeck, and Dr. Kirsting are leading an expedition to the Hinterland of New Guinea.

Dr. Nils Holst, the Swedish geologist, is to travel for a year in West Australia under the auspices of the Anglo-Scandinavian Exploration Company.

Mr. Roy W. Squires, says *Science*, goes to Venezuela as a representative of the Department of Botany of the University of Minnesota and under the auspices of the Orinoco Company. He will make collections in the unexplored mountain regions south-east of Barancas. The region covered will lie considerably south of that visited by previous botanists, and a valuable collection may be looked for. Mr. Squires will be absent from Minnesota about six months.

After the publication of our last number, Professor D. G. Elliott, who was to have gone to South Africa, altered the destination of his expedition to Somaliland, whither he sailed on March 27, accompanied by Mr. Dodson, who was with Dr. Donaldson Smith's expedition to Lake Rudolph. Landing at Berbera, Mr. Elliott will pass southwards over the plateau to the Shebeyli River, and will return down the valley of the Juba River.

Those of our readers who are in the habit of receiving scientific papers from their American colleagues should note that in future such second-class mail-matter for Europe will have to wait the departure of the American Line steamer on one day in the week, unless the packages are specially marked by the sender to be forwarded by an earlier steamer or another route.

CORRESPONDENCE.

Hydrachna globula (DUGÈS).

IN breaking up a specimen of *Dytiscus marginalis*, which had been in spirit for some months, I found a nymph of *Hydrachna globula* (Dugès) imbedded in the fat-body on the left side, near the first abdominal spiracle. Since then I have learned that Mr. G. E. Mainland, F.R.M.S., had a similar experience some years ago. Dr. Trouessart has kindly identified the specimen for me, but he offers no suggestion as to how the mite—common enough as an external parasite on *Dytiscus*, *Nepa*, and *Notonecta*—got into such strange quarters. I shall be grateful for help on this point. The specimen is now at the British Museum (Nat. Hist.) in the care of Mr. Pocock.

9 Cavendish Road, Harringay, N. HENRY SCHERREN.

A COUNCIL OF ZOOLOGISTS.

YOUR proposal with reference to the Nomenclature question is an interesting one. If it be possible for the German Zoological Society to publish a synopsis of the Animal Kingdom, it certainly should be possible for the names of extinct species to be added to it. Assuming the truth of Dr. Sharp's estimate as to the number of recent species (and almost the same estimate has been made independently and synchronously by an American systematist), we need not suppose that it would be so very greatly increased by the addition of extinct species. It is the Insecta that swell the numbers of recent species, but their fossil representatives are very few. Perhaps a series of Palæontological Appendices to the various parts of "Das Tierreich" might be arranged. But you are right in urging the prior completion of a list, such as Mr. Sherborn's "Index Specierum."

When the Council which you suggest has been appointed, it might draw up an "Index Expurgatorius" of publications. There are writers who, without doubt, should not be treated as serious workers, and who would be blackballed by all true zoologists. RECORDER.

SOME CORRECTIONS.

MR. THEODORE GROOM asks us to state that in his letter in our April number on p. 287 the words "long cylindrical glass troughs" should be "long rectangular glass troughs." In the third paragraph of Mr. PYCRAFT's article on "The Wing of Archæopteryx," p. 261, the implication that Dr. Hurst regarded the bone that he *provisionally* named (not identified as) "ulnare," as belonging to the proximal row of carpals, is contrary to fact. It was also incorrect to state that Owen figured it as the radiale.

NOTICE.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

TO THE TRADE.—NATURAL SCIENCE *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

THE "CHALLENGER" NUMBER.—*In reply to enquiries, we remind our readers that, although the* FIRST *edition of this ran out of print immediately, there are still some copies of the* SECOND *edition to be obtained at the usual price*—ONE SHILLING. *No more will now be printed, so orders should be sent at once.*

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 52. Vol. VIII. JUNE, 1896.

NOTES AND COMMENTS.

Progress at the Natural History Museum.

THE most obvious change that has lately been made at the British Museum (Natural History) is the removal of the huge skeleton of the sperm-whale from the middle of the entrance-hall to a more appropriate place in the large temporary room recently erected at the back of the Museum for the Cetacea. This will make room for more of the beautiful cases that illustrate such subjects as Mimicry, Protective Coloration, Seasonal Variation, and Albinism.

The Introductory Series, or "Index Collection," arranged under the supervision of Sir William Flower in the bays round the central hall, continues to advance. The work begun many years ago by the late R. S. Wray, then assistant to the Director, is being continued in the same careful manner by his successor, W. G. Ridewood, with all the advantages of modern museum technique. The latest portion of the series to be finished is in the bay devoted to the anatomy of fishes, including the lancelet and the lampreys, and illustrates the structure and development of fishes' teeth. A paper which may serve the student as a companion to, and memento of, this exhibit has kindly been contributed by Mr. Ridewood to the present number; the illustrations to it are not mere reproductions of text-book *clichés*, but have been accurately drawn from the exhibited specimens by Mr. J. Green.

We may remind our readers that we have already published articles on portions of this Introductory Series, namely, "The Teeth of the Horse" (vol. vi., p. 249, April, 1895) and "Morphology at the National Museum" (vol. vii., p. 258, October, 1895). We hope that, as the work progresses, we may be able to furnish students with more of these valuable summaries.

Birds and Mammals at the British Museum.

Passing into the Zoological Department, we find changes taking place on all sides, and some of them form the subject of Sir Henry Howorth's "Casual Thoughts" on a following page. The nests of

British song-birds have been brought down from the corridor, and now stretch from the Bird-gallery, across the Coral-gallery, down the middle of the Reptiles; this disposition is far from elegant, but the birds are at all events near their fellows, and we are not sorry to see some of the gaping crocodiles placed in a less conspicuous position. We welcome, however, *en passant* a really fine and well-mounted specimen of *Tomistoma*, a crocodile from the Malaccas. The corridor from which these birds have been removed is now being filled by the stuffed specimens of African antelopes, among which the magnificent Kudu has a prominent position. Thus room is made in the adjoining Mammal-gallery for an extensive series of admirable alterations, being carried out by Sir William Flower with the assistance of R. Lydekker. The first principle of the change has been to bring the various specimens of the respective groups into proximity. Thus, the Monotremata occupy two glass cases near the entrance; the first bay on the right is devoted to Marsupialia; the second, to Edentata and Sirenia (Cetacea cannot be represented here on account of their size, so the visitor is informed where they are to be found); the next bay is occupied by Suina; the fifth by Camelidæ; then follow the rest of the artiodactyle ungulates up to the end pavilion, which is filled with specimens of *Bos* and *Ovis*, of which the Museum has a fine collection. The perissodactyle ungulates and the rest of the Mammalia will be arranged in the bays along the other side of the gallery. The arrangement is purely systematic, but an attempt is made to bring out the meaning of the system by calling attention to the diagnostic characters of Orders, Families, and Genera, with the help of explanatory labels and specially prepared osteological specimens. Each genus is exemplified, but only such species are exhibited as show range of variation in structure or of distribution. The distribution of the divisions, from Orders to Species, is shown by maps of the world of gradually decreasing size; thus the greatest detail has to be shown on the smallest map, a difficulty which might be got over by having maps of the zoö-geographical provinces for the species, since a species is rarely found in more than one province. Where not required for exhibition purposes, the upper portions of the lofty wall-cases are blocked in, the fronts being used for maps and explanatory labels, and the backs for the storage of duplicate stuffed specimens. The gaps in the modern systematic series, caused by the extinction of many families and genera, are filled by specimens, photographs, and labels, while the visitor is also directed to the corresponding exhibits in the Geological Department. The latter department has followed this plan for some time, so far as recent animals are concerned, and we are glad to see it at last adopted by the Zoological Department. Nevertheless, it brings out more clearly than ever the not only unphilosophical, but unpractical, character of our separation of animals into recent and fossil; for as each department advances towards its ideal, we see evolved

two independent series of zoological exhibits, each complete in itself, but the one rather richer in skins, and the other better supplied with fossils.

Uintacrinus at the British Museum.

We have already drawn attention to recent important acquisitions of fossil Vertebrata, to which might be added the bones of *Æpyornis*, collected in Madagascar by Dr. Forsyth Major, and exhibited at the *soirée* of the Royal Society. Among Invertebrata new to the Geological Department, the place of honour goes to a fine slab of Niobrara Chalk from West Kansas, containing twenty-two crowns of the free-swimming crinoid *Uintacrinus*. Since remains of this genus were first found, twenty-six years ago, in N. America and Westphalia, and described almost contemporaneously by Grinnell and Schlueter, our knowledge of its structure has not greatly advanced. It has presented zoologists with a puzzle for which they have attempted

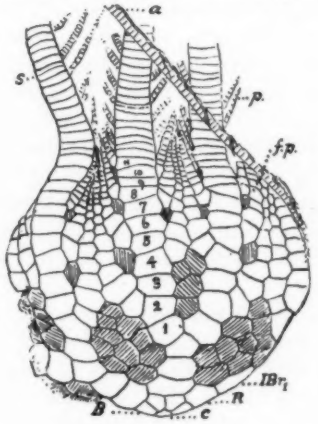


Fig. 1.

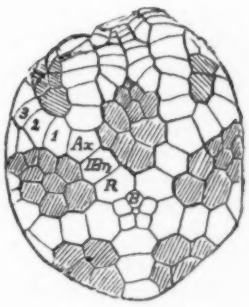


Fig. 2.

Uintacrinus socialis, Upper Cretaceous of America, ⅔ nat. size.

Fig. 1, from the side. Fig. 2, from below. *c*, centrale; *B*, basals; *R*, radials; IBr_1, first primary brachial; *Ax*, axillary brachial; 1, 2, 3, etc., secondary brachials, bearing *p*, pinnules, some of which are included in the walls of the cup, viz., *f.p*. The intercalated plates, which bind these elements together, are shaded.

many solutions. The large cup, with numerous plates intercalated between the radii, suggested to them that *Uintacrinus* was a straggler from the host of what used to be known as the tessellate crinoids of the Palæozoic era, and while a few connected it with the Rhodocrinidæ, the majority, among whom is Von Zittel in the "Palæontologie" reviewed in our last number, referred it to the Ichthyocrinoidea. Its want of a stalk, and perhaps its occurrence in precisely the same zone as *Marsupites*, have caused many to ally it with that similarly puzzling crinoid.

The British Museum specimens were carefully investigated by

F. A. Bather, whose results are published in the last number of the *Proceedings of the Zoological Society* (vol. for 1895, pp. 974–1,004, pls. liv.–lvi.). A restoration there depicted shows *Uintacrinus* swimming about in swarms, with ten arms, each over 3 feet in length. These arms contain numerous syzygies, or brittle immovable unions, between their ossicles, indicating points at which the arms could readily be broken off if they became entangled in those of other individuals. But the most interesting part of the paper is that which discusses the affinities of *Uintacrinus*. It is pointed out that the absence of a stem is a feature common to genera drawn from diverse groups. *Marsupites*, *Saccocoma*, and *Uintacrinus* are three genera that have no trace of a stem or of any anchoring organs, but in other respects are of dissimilar structure. The points in which they resemble one another, viz., the large size of the calyx, and the presence of a centrale, are therefore held to be secondary features. The essentials of structure in *Uintacrinus* being determined, it is shown that they are quite different from those of all crinoids with which previous writers had connected the genus. On the other hand, the resemblances to the Pentacrinidæ lie in essentials, and the main difference—the intercalation of interbrachial plates—is of a secondary nature. The author maintains that the Triassic pentacrinid, *Dadocrinus*, possesses just those features which must have been possessed by the ancestor of *Uintacrinus*, and also shows a tendency to the intercalation of tegminal plates between the arms. *Uintacrinus*, he concludes, is descended from the palæozoic Crinoidea Inadunata, and branched off from the ascending line that contains *Encrinus*, *Dadocrinus*, *Pentacrinus*, and *Apiocrinus*.

The moral of the paper seems to be that more detailed knowledge is needed about forms that we are supposed to know fairly well, and that speculation is useless until such knowledge is gained. We hope that Mr. Bather may be able before long to complete the studies which, he hints, he has long been making on *Marsupites*.

A NEW SOUTH AMERICAN MAMMAL.

It is notoriously difficult to understand the relationships among living and extinct marsupial animals. No doubt marsupials represent the highly modified and divergent descendants of a decaying group, and it might be expected that the gradual discovery of the remains of extinct forms would lead to a better understanding of the modern relics of the group. Up to the present time, however, the palæontological discoveries have not made the questions simpler, and Mr. Oldfield Thomas' account (*Proc. Zool. Soc. London*, 1895, p. 870) of a newly discovered American marsupial, has added, in a very unusual fashion, to the interest and to the difficulties of the question. If we accept Mr. Oldfield Thomas' view that syndactylism is a character that may have been acquired secondarily by different sets of

marsupials, the most important anatomical distinction in the group relates to the character of the incisor teeth of the lower jaw. One great division is termed *Diprotodont*, because the median lower incisors are enormously long, are horizontal in position, and dominate the aspect of the front of the mouth. The other great group is described as *Polyprotodont*. In these, as in existing carnivorous animals, the large canines are the chief feature of the front of the lower jaw, while the incisors between them are small and inconspicuous. A few years ago it would have been asserted confidently that Diprotodont creatures, living or extinct, were peculiar to Australia and the adjacent islands. Recently, however, Señor Florentino Ameghino has described a number of fossil Diprotodont creatures from the rocks of Patagonia. The age of the geological strata in which these interesting fossils were found is doubtful. Ameghino thinks that the beds are Middle Eocene. Mr. Lydekker, who has examined the remains more recently, regards them as much later, probably as Oligocene or Early Miocene.

Here, however, is a link binding together Australia and South America, and pointing vaguely towards a former land-connection between the extremities of land in the Southern Hemisphere. Much weight could not have been laid upon the existence of Polyprotodont marsupials in Australia and in South America, because, not only do these extend into North America, but fossils referred with considerable certainty to the Polyprotodonts occur throughout the Northern Hemisphere. The Diprotodonts, however, living and fossil, are known only in South America and the Australian region. It was possible to argue, while only Ameghino's fossils were known, especially if there were accepted his ascription to the Eocene Period of the beds in which they were found, that Diprotodont fossils might yet be found in the Northern Hemisphere, and that their occurrence in Patagonia was no strong argument for the existence of a recent land-connection between Australia and South America. Mr. Thomas' new mammal, *Cænolestes obscurus*, recently obtained by a native hunter in Bogotà, and now in the British Museum, strengthens the case for the land-connection enormously. For Mr. Thomas, in his careful account of the characters presented by the skull, proves that it belongs to the Epanorthidæ, one of Ameghino's fossil Diprotodont families. The Diprotodonts, living and fossil, therefore, so far as is known, are confined to Australia and South America, and occur in both these regions.

Lime in Plant Chemistry.

In the most recent issue of the *Annals of Botany* (vol. x., no. 37) P. Groom gives an account of some experiments on the function of calcium in plant chemistry. It is well-known that plants will not thrive unless supplied with a small amount of calcium in their food; one of the symptoms of mal-nutrition when this element is absent being the accumulation of starch in the tissues.

More than twenty years ago Boehm came to the conclusion that one of the functions of calcium was to assist the carrying of carbohydrates. Working subsequently on the same subject, A. F. W. Schimper showed that, in plants which normally contain crystals of calcic oxalate, oxalic acid is a bye-product in the building up of proteids, and that, in the absence of calcium, acid potassic oxalate accumulates in the leaves and buds and acts as a poison. He concluded that the calcium served to neutralise this salt, but played no fundamental part in the conduction of carbohydrates, since these were proved to travel without a corresponding movement of calcium.

Groom suggests that the choking of the tissues with starch may be due to the fact that potassic oxalate arrests the change of starch into sugar, and shows by experiment that the diastatic action of extract of malt upon arrowroot-starch is hindered by even very dilute solutions of the acid salt; also that the same substance retards the process of the change of starch into sugar in the living leaf of the Canadian water-weed (*Elodea canadensis*); and further, as the soluble oxalate accumulates, that the manufacture of starch is retarded, and, finally, the protoplasm is killed. The possibility of the diastatic action in plants, which, like *Oxalis*, normally contain a considerable amount of acid potassic oxalate in solution in their leaves, is explained by the fact already elucidated by Giessler, that the salt is stored in the epidermis, not in the assimilating tissue. Giessler suggested that the object was protection from snails and the like, but Groom thinks, from his own experiments, that the protective significance is at most secondary, and that the primary reason of the superficial storage of the oxalate is because its presence in the underlying tissues would derange the metabolic processes.

THE FLORA OF THE SOONDREEBUN.

THE issue of the *Proceedings of the Linnean Society* (from November, 1894, to June, 1895), which has recently appeared, includes an interesting presidential address by Mr. C. B. Clarke on the Soondreebun of Bengal. This contains not only an account of the flora of the district, but also notes on its geography and natural phenomena. The derivation of the name is a much disputed point; Mr. Clarke adopts the one which gives the word as Soondree-bun, meaning the forest of "Soondree," or *Heritiera Fomes*, a prevalent tree in the salt-water swamp-forests of the mouths of the Ganges, and important from an economic point of view. The area included is about 8,000 square miles, and by no means uniform in character. There are large tracts of mud flooded at high water, but becoming hardened in the sun at low tide, when it is possible to walk for several hours among the scattered and open mangrove vegetation. There are also large open areas of grass, and, thirdly, the Soondreebun proper, with dense jungles of Soondree on tolerably firm mud, broken in all directions by creeks. The grass jungles are full of beasts; the tiger,

here very dangerous to man, the buffalo, the axis-deer, and a rhinoceros are characteristic larger animals. All are quite at home in the water. The tiger swims long distances, and there is a wonderful story of an elephant which, carried one night out of sight of land by a north-wester, swam all next day, and the following morning brought his mahout, nearly dead with thirst, safe to land. Mr. Clarke does not think the presence of the larger animals in England an *à priori* proof of a former land-connection with the Continent.

The greater part of the paper is, however, devoted to a consideration of the geographic distribution of the *characteristic* vegetation of the district, and gives a most instructive lesson to workers in systematic botany. There are sixty-nine species, about one-sixth of the whole flora, which grow in the Soondreebun, but not in the Bengal plain for 100 miles outside the Soondreebun. These characteristic plants are here tabulated so as to show their distribution in longitudinal areas east and west of the district. The tables show that the range of all the sixty-nine is continuous, each plant being found in every intermediate area between its extreme eastern and western limits. Thirty-two species extend to China, the same number to the Pacific Islands, but only eight to America, among which are the only six found in the Sandwich Islands. Eighteen plants extend westwards to Mascarenia, and fourteen to the east coast of Africa. The number of species in common is found to diminish regularly as we get further from the centre. Of the 69 plants selected, 53 occur in Burma, 45 in the Malay Peninsula, 43 in Malaya, 32 in Tropical Asia, and so on; and a similar relation would, it is suggested, result if the characteristic plants of Hampshire were selected and their distribution similarly represented in the maritime counties from Kent to Cornwall. Not the least value of Mr. Clarke's address is in the emphasis he lays on the results to be obtained by working with a few well-defined easily recognised species rather than from a comparative tabulation of whole floras. "An investigator should look round well (before commencing an inquiry) to discover the simplest case, that in which he may observe and record the action of the smallest number of causes acting at the same time. This is a commonplace remark: chemists understand the principle very well; but I think biologists require reminding that human industry is limited, and that their zeal, great as it is, ought only to be expended in the most economic manner."

Ehret.

As an appendix to the same issue of the Linnean Society's *Proceedings*, is a memoir of the famous flower painter, George Ehret, translated by Miss E. S. Barton from his own MS., now kept in the Botanical Department of the British Museum, where are also a number of his drawings. Ehret was born at Heidelberg in 1708, and spent a large portion of his life as a working gardener. His story is

one of assiduous perseverance. He seized every opportunity to perfect himself in the art of accurately and scientifically depicting plants, and at the date of writing the memoir (1758) he was living in London, a Fellow of the Royal Society, and so famous as an instructor in the "painting of plants and flowers" that, to quote his own words, "If I could have divided myself into twenty parts I could have had my hands full."

AUSTRALIAN TERMITIDÆ.

IN the *Proceedings of the Linnean Society of New South Wales*, July, 1895, Mr. W. W. Froggatt has published the introduction to a study of the Termites of Australia. It is chiefly devoted to particulars as to the importance of these insects in other parts of the world, and is no doubt to some extent prompted by a desire to obtain sympathy or assistance in carrying out an extensive and much-needed work. We hope that he will be successful and enabled to prosecute his work thoroughly. We anticipate that it will prove more laborious and difficult than he supposes, for the northern parts of Australia are now among the headquarters of termite operations, and the species and varieties of white ants are much more numerous than is commonly believed, while their habits and economy present profound differences, which it is of the first importance to unravel. There are only about one hundred species of termites known from all the world, but Mr. G. D. Haviland, who has a greater acquaintance with the exotic forms than anyone else, has obtained evidence which satisfies him that there exist some hundreds of species in the island of Borneo alone. It is probable that the Australian species are numerous, though only six have yet been ascertained to exist there. We fear, from Mr. Froggatt's remarks, that he has not yet obtained sufficient material for his purpose. If an effort to elucidate the termite fauna of Australia is to be really successful it must be based on extensive and well-collected material, obtained in larger part from the Termitaria themselves. It is of less advantage to collect the winged forms away from their nests, because they cannot then be associated with their wingless fellows, which, from the naturalist's point of view, are of the greatest interest. The nests should be examined at the period of swarming, and winged specimens should be taken from the nest as well as soldiers, workers, and young; the queen and king should also be looked for, and should, if found, be preserved, together with the other forms from the same nest. It is of little use to attempt to work out the habits and life-histories until the distinct species have been elucidated; there exists very great confusion in termite literature, and much of it is due to observations made on one species being mixed up with those derived from others that have been supposed to be the same, though really different. When the species have been satisfactorily discriminated, the resident naturalists will no doubt be able to make out the life-histories and habits in a useful manner. In

speaking of the remarkable termite that always places its nest with the same orientation, Mr. Froggatt terms it the magnetic termite. This is an unfortunate name, and was not used by Mr. Le Sœuf (quoted by Mr. Froggatt), who called this species the meridian termite, the appellation that has also been used by Mr. J. J. Walker and others. We hope Mr. Froggatt will not be discouraged by the difficulties he will have to overcome, and that he will receive assistance from every one able to give it.

The Search for Water in Queensland.

A year ago (vol. vi., p. 364, and p. 82 *antea*) we gave some account of the investigations being made by the Geological Survey of Queensland in search of artesian water. A paper recently read by Mr. Jack, the Government Geologist, before the Royal Society of Queensland gives further details regarding the progress of this work. Under ordinary circumstances it would be cheering to read of "a number of unsuccessful bores having been put down in the north-western portion of the colony," but in the present connection the information is rather disappointing. The experience, however, indicates that artesian water must not be sought for north of a line that extends from the boundary of the colony, by the Tropic of Capricorn, to the Georgina River, and thence north-eastward (perhaps not in a straight line) to the head of the Warburton River. North of this line are none of the water-bearing Cretaceous rocks, but their place is taken by metamorphic rocks whose age may be either Archæan, Cambrian, or Silurian, or one or other or all of these. Some hopes had been raised by the references of the earlier explorers to "rolling downs" and "Mitchell grass" up the Georgina River, but, as Mr. Jack points out, limestone of any age is likely enough to furnish open, rolling, and well-grassed "downs" country.

Science "Written Up."

We are well aware that our contributors are devoid of the lurid craft of the reporter, and that we cannot trick out our cold facts in the meretricious charms of the popular Press. We are indebted to Dr. Herbert Hurst for sending us a delightful specimen of how science should be written. It is apparently a perversion of Mr. Pycraft's account of *Opisthocomus* which appeared some short time ago in our columns (Natural Science, vol. v., p. 358). We did not induce the Manchester *City News* to copy directly from us, but *Science Siftings* fetched it with the following paragraph. Our compliments to the Editor of *Science Siftings*:—

"A Four-Legged Bird.

"*Science Siftings* says: Nothing in the realm of natural history in late years excels in interest the announcement we are able to make of the discovery in British Guiana of a bird with four legs. The Crested Hoatzin (*Opisthocomus cristatus*), the only survivor of a race of

birds, several of which are known as fossils, inhabits the most secluded parts of the forests of South America, and it is probable that it is owing to its retiring habits it has outlived its congeners, as well as to the fact that, feeding as it does upon wild arum leaves, its flesh acquires so offensive a flavour as to have gained it the name of the 'stink' bird, and to render it entirely unfit for food. It is a large bird, almost as large as a peacock, in fact, but is very seldom seen. Oftener its loud wailing cry is heard.

"The chief peculiarity of the Hoatzin consists in the fact that when it is hatched it possesses four well-developed legs, the front pair being of a reptilian character. The young birds leave the nest and climb about like monkeys over the adjoining limbs and twigs, and act and look more like tree toads than birds. After hatching, the modification of the fore-limbs begins, the claws of the digits falling off, and the whole of the claw-like hands becoming flattened, change into wings. After this modification has taken place, feathers begin to grow, and in a short time not a vestige remains of its original character. The adult birds not only have no claws upon their wings, but their thumbs, even, are so poorly developed that one would hardly suspect that in the nestlings we have the nearest approach to a quadruped found among existing birds."

IN POST OCTAVO.

IN view of recent attempts to resuscitate the quarto *Transactions of the Geological Society of London*, an editorial by Professor J. C. Branner in the February–March number of the *Journal of Geology* may be read with profit. On behalf of the field-geologist it pleads for books with a small page. Big books cannot be carried in the field, and are inconvenient even in the library. "Small books will serve equally well the man in the office or in the field, in camp or on horseback. The taking of books into the field should be encouraged; our laboratory is there, and there is no other place in which a book can render such lively service." So far as descriptions of topographic geology are concerned, there is much force in these remarks, and there is no doubt that experience of books in general confirms the arguments of Mr. Branner. A study of the evolution of scientific periodicals and the publications of learned societies has already been made by some ingenious Americans, and it has been shown that the octavo form has in nearly all cases survived as the fittest. "There is no advantage in very large type," says the *Journal of Geology*. "There is no advantage whatever to a working geologist or to a student for his books to have large pages, wide margins, or to be printed on unnecessarily thick paper." True though these statements are, their occurrence in the *Journal of Geology* is curious. Its current number of 128 pages, and weighing 12¾ ounces, contains about 51,600 words, whereas our last number of 72 pages, and weighing 4½ ounces, contains about 43,000 works. In these estimates, illustrations and blank space are reckoned as words. To put it another way, an average page of NATURAL SCIENCE, which is of the same height but six-sevenths of the width, contains just half as many words again as

a page of the *Journal of Geology*; while an equivalent weight of NATURAL SCIENCE would contain far more than twice as much matter. We use our own Journal for comparison merely because it is the nearest to our hands, and doubtless our valued contemporary makes up for this discrepancy by the greater weight of its words.

THE LIVER FLUKE.

SINCE the classical researches of A. P. Thomas on this parasite of the sheep, all naturalists have known that its larval stages, under the peculiar shapes known as *redia* and *cercaria*, are developed in the snail *Limnæa truncatula*, and that the *cercaria*, eventually escaping from the snail, encysts itself either on a water-plant or on blades of grass, where it is readily eaten by sheep. Some members of the Field Naturalists' Club of Victoria have recently obtained from the fresh-water snail, *Isidora tenuistriata*, large numbers of *redia* and *cercaria* similar in form to those found in *Limnæa truncatula*. They have also been found in *Isidora texturata*, *Ancylus tasmanicus*, and a species of *Planorbis*. Other forms of *cercaria* have been detected in *Segmentina victoriæ*, *Planorbis gilberti*, *Isidora gibbosa*, var. *fusiformis*, and *Limnæa lessoni*. These may of course belong to some other species than *Fasciola* (or *Distomum*) *hepatica*.

"What causes surprise," says the *Victorian Naturalist*, "is the wonderful amount of ingenuity which the ciliated embryo fluke employs in obtaining admission to the pulmonary chamber of such snails as *Planorbis* and *Ancylus*. The former takes the shape of a disc only $\frac{1}{16}$ in. thick and $\frac{1}{8}$ in. across, whilst the latter can scarcely measure half that size. Our special climatic conditions evidently arouse desire in the embryo to widen its choice in the matter of suitable hosts. This fact unfortunately multiplies the chances of the increase of fluke, for whilst only one species of one genus favours the transmission of the pest in Europe, at least three or four different genera must be credited to Australia."

As stated above, it is supposed that sheep eat the fluke in its encysted form upon grass or water-weed. The Rev. W. Fielder has, however, observed that cysts are formed actually within the snails *Planorbis* and *Ancylus*, molluscs which, from their small size, may easily be swallowed by the sheep when drinking. Mr. W. McCaw has also noted cysts within *Isidora tenuistriata*. Possibly, as the *Victorian Naturalist* suggests, this last stage of larval life has also been influenced by the special climatic conditions. Anyway, the danger to sheep is still further increased.

"REMEMBER MITCHELSTOWN!"

THIS continues to be the watchword of the green-coated *Irish Naturalist* (we refer, of course, to our estimable contemporary, so ably conducted by G. H. Carpenter and R. Lloyd Praeger, not to any individual), and an excellent watchword it is. In a note headed

"Irish Cave Dwellers" (vol. vi., p. 148) we gave an account of the interesting researches by Mr. Carpenter into the fauna of the celebrated cavern; these are continued in the April number of the *Irish Naturalist* by Mr. H. Lyster Jameson, who was assisted in his exploration by a grant from the Royal Irish Academy. The chief addition made by him is the spider, *Leptyphantes pallidus*, which is new to the Irish fauna. This is a rare species that has been found by Mr. Pickard-Cambridge in Dorsetshire, at roots of heather, also in caves of France and Bavaria. Mr. Jameson also found the mollusc, *Hyalina contracta*, which, though it occurs in Sweden, Germany, France, and Switzerland, had hitherto been found in the British Isles only at Killarney, by Dr. Scharff. Mr. Jameson has also examined the caves at Enniskillen, which are of less age than that at Mitchelstown, and contain a fauna less purely troglodytic in character. By further investigations among the many unexplored caves of Ireland, he hopes to fill up the gaps in the history of the evolution of cave-faunas.

This paper is followed by one from Mr. E. A. Martel, President of the Société Spéléologique of Paris. He gives a survey of the cave, and a plan on the scale 1:2000. Three things, he says, are remarkable in Mitchelstown Cave:—

"1st. Its ramification in every direction, and the infinite subdivisions of its central parts.

"2nd. Its extent, which attains and even exceeds, including all the passages, one mile and a quarter. This must be the longest cave, yet known, in the British Isles.

"3rd. Its blind fauna. It is the only grotto in England, Scotland, or Ireland where, up to the present time, there have been found animals peculiar only to caverns."

"The cave of Mitchelstown," he concludes, "may still be considered as a worthy object for interesting future work and research."

The May number of the *Irish Naturalist* contains a further list of Irish caves, by R. Lloyd Praeger.

Blind Animals.

An interesting discovery of blind animals has recently been made at San Marcos, Texas, U.S.A., where, in sinking an artesian well to supply water for the station of the U.S. Fish Commission, a subterranean stream was struck at a depth of 181 feet. The water flowing from this well contains numerous shrimps and a lesser number of Isopoda and Amphipoda, as well as a few batrachians, all new.

The batrachians are characterised by their extremely long and slender legs, which may serve as tactile organs, and by their broad, flattened, squarish snout. The species is related to the North American *Necturus* and the European *Proteus*, and has been named *Typhlomolge rathbuni* by Dr. Stejneger (*Proc. U.S. Nat. Mus.*, vol. xviii., No. 1,088).

The crustaceans have been named by J. E. Benedict *Palæmonetes antrorum*, *Cirolanides texensis* and *Craugonyx flagellatus*. It is an interesting fact that the nearest relative of the new genus *Cirolanides* is a salt-water genus, *Cirolana*, and this raises the question of a possible former connection of the subterranean stream with the ocean.

The interest of these communications is great, but is it sufficiently great to necessitate the publication of these new names without figures and with descriptions professedly incomplete? Mr. Benedict's word may be taken for the fact that the mouth-organs of *Cirolanides* are those of the family; but in view of the varying meanings attached by systematists to the name *Craugonyx*, we must deplore that this preliminary notice contains nothing by which Mr. Benedict's accuracy in calling the new species a *Craugonyx* can be tested, while there is, moreover, nothing to show what definition of that genus he accepts.

The New Photography and Natural Science.

Hitherto we have not said much about the X-rays, chiefly because in their physical aspects they lie outside our scope. It is partly for this reason, and partly because we prefer in such cases to wait for the publication of the complete work, that we refrain from discussing a *vorläufige Mittheilung* "Ueber einige Eigenschaften der Röntgen'schen X-Strahlen," by Drs. A. Winkelmann and R. Straubel, extracted from the *Jena Zeitschrift* and kindly sent us by Mr. Gustav Fischer. The time is, however, come when something should be said about the application of skiagraphy to anatomical purposes. At the recent *soirée* of the Royal Society, the walls of the Council Room were almost entirely papered by a series of skiagrams exhibited by Mr. Sydney Rowland. These illustrated the considerable use that surgeons have already made of this new method of research. About 20 per cent. of them included the discovery and location of foreign bodies, needles, bullets, etc., lodged in soft tissues, and in one case of a coin lodged in the intestine, which had caused troublesome symptoms. In one of these cases two fruitless operations had already been performed. Fifteen per cent. of the cases were instances of pathological conditions of the elbow joint of more or less obscurity, on which new and unexpected light was thrown by the diagnosis thus obtained. In 10 per cent. of the cases the object was the determination of the extent and distribution of tuberculous lesions in bone. The same enterprising gentleman is the editor of a new serial entitled "Archives of Clinical Skiagraphy," of which the first number has lately been issued by the Rebman Publishing Co., London, price 4s. The plates include one of the skeleton of a living child, and five showing injuries to the knee. The *Photogram*, however, points out that, although many of the skiagrams undertaken for surgical purposes have been successful, in others, with conditions apparently the same, the results have been very disappointing. Photographers and physicists will have to do much more work on the subject before the

process can be relied upon by surgeons. We learn also from this journal that Dr. Macintyre, of Glasgow, who was the first to complete the skiagraphic survey of the body of an adult, has proved that it is quite possible to skiagraph the bones of the skull, and to show very complete details of its structure. "This is rendered possible by the fact that the thickness of the head allows considerable dispersion of rays, so that the varying structure of the side of the skull furthest from the dry plate causes no definite shadow at all, while the one that is nearest to the plate gives a perfectly sharp image, full of detail of the bone-structure." At the Royal Society's *soirée* many of the visitors amused themselves by studying their own skeletons with the aid of the apparatus exhibited by Mr. A. A. C. Swinton and Mr. Herbert Jackson.

It is, however, the applications of this process to zoology that are of more interest to our readers. At the meeting of the Zoological Society on May 5, Mr. W. E. Hoyle exhibited a remarkably fine skiagram of a snake in the act of swallowing a mouse; but, unfortunately, the most remarkable point about it was that the snake was a grass snake, which never touches mammals, but only such cold-blooded prey as frogs and lizards. Mr. G. A. Boulenger, who followed with a paper on some Batrachians from the Caucasus, has been one of the first to use the X-rays for purposes of systematic zoology. In studying the new toad, *Pelodytes caucasicus*, which is only the second species of the genus known (the other, *Pelodytes punctatus*, being confined to Western Europe), skiagrams had enabled him to determine all the more important points in the structure of its skeleton. The value of the application of this method lies in the fact that only a single specimen of the species is known, and this, being in the British Museum, cannot be cut up to determine its osteological characters. In this particular case, moreover, these characters are of much significance, one of them, the junction of the calcaneum with the astragalus, occurring in *Pelodytes* alone among the Anoura; this peculiarity is clearly shown in the photograph, as also are the form and extent of the fronto-parietal fontanelle, the shape of the enormously-expanded sacral transverse processes, and the direction of those in the lumbar region. Here, too, we may refer to a skiagram of *Astropecten irregularis* sent to *Nature* by Mr. Alexander Meek. The more interesting features shown by it are the various food-bodies and their position in the stomachic cæca.

Experiments made by W. G. Miller, of Kingston, Ont., and published in the *American Geologist* for May, p. 324, seem to show that the X-rays may prove an aid also to the petrologist and mineralogist, though they will hardly supplant polarised light. Botanists and palæontologists have not as yet shown any eagerness to adopt this method: we suggest it to the disputants over *Archæopteryx*, as no less efficacious than controversial personalities.

The most striking of all the exhibits at the Royal Society's

conversazione, namely, Professor Lippmann's colour-photographs, produced in a collodion or gelatin film by interference, are not, in their present state, of much use to zoologists; but the remarkable instrument which Mr. F. E. Ives showed under the name of Stereoscopic Photo-chromoscope, suggests a possible application. The photo-chromoscope camera makes, at a single exposure on a commercial photographic sensitive plate, three pairs of images which, by differences in their light and shade, constitute a record of everything that excites vision in the two eyes. The stereoscopic photo-chromoscope translates this record to the eyes, so that the object appears to be seen through it in its natural shape and colours. It is clear that this apparatus gives us an easy means of recording fleeting changes of colour, and it would be of much value in the study of living animals and plants. It may also be possible to use its principle for the future development of those methods of colour-printing which depend on the use of a series of half-tone blocks. There are, however, technical difficulties in the way of superimposing many colours by means of such process-blocks, and these have yet to be overcome by engravers and printers.

Some Faunal Notes on Birds.

It is pleasant to be able to call attention to the unpretentious, but none the less valuable, services of the Perthshire Society of Natural Science, although we are forced to mourn the loss which its members have sustained in the death of their veteran leader, the late Colonel H. M. Drummond Hay, C.M.Z.S. Vol. ii., part iii., of its *Transactions* opens with an interesting paper by J. A. Harvie Brown upon the Scottish distribution of the Marsh Tit. In this connection, attention should be called to the extensive and important article on the same species, which has lately appeared in the same author's "Fauna of Moray." Lieut.-Colonel Campbell, the Governor of H.M. Prison, Perth, follows Mr. Harvie Brown's discursus on *Parus* with a happily-conceived essay on the "Ornis" of Perthshire. This paper suffers somewhat from the fact of its having been written for a popular audience. It succeeds, nevertheless, in conveying a good impression of the species which constitute the local avifauna. There are a few mistakes. Colonel Campbell tells us, for example, that he met with the Great Grey Shrike (*Lanius excubitor*) in Southern Spain, where no doubt he really came across the Southern Grey Shrike (*Lanius meridionalis*). But slips of this kind will not mislead an experienced eye, and the tyro cares for none of these distinctions of science. Taken as a whole, the essay reflects credit on an excellent naturalist, and we thank him for the research which he has brought to bear upon a congenial topic.

The same number of these *Transactions* includes a dainty, if brief, essay upon the habits and idiosyncrasies of the dipper (*Cinclus aquaticus*), from the pen of Lieut.-Colonel W. H. M. Duthie. We

never read a prettier account of the doings of this sprite of our highland burns. It is brimful of realism.

An interesting paper on *Diomedea melanophrys* in the Faeroë Islands, has been communicated by W. Eagle Clarke to a recent issue of the *Proceedings of the Royal Physical Society* (vol. xiii., part i., pp. 91–114). Ornithologists will recall the surprise which was felt when the news arrived that an adult example of *Diomedea melanophrys* had been shot in the Faeroë Islands in May, 1894. This bird, which met with its fate at the hands of a native gunner on Myggenaes Holm, was well known to the fishermen, who had seen it consorting with gannets (*Sula bassana*) for no less a period than thirty-four years. It is a pity that it met its unauthorised doom just before Mr. Harvie Brown and Mr. Hugh Popham visited the locality in their yachts. Otherwise we might have had the pleasure of reading some remarks upon its habits by skilled naturalists. The bird was skinned and forwarded to Mr. Knud Andersen, of Copenhagen. This gentleman has drawn up, for the Physical Society, a careful statement of all the circumstances connected with the occurrence of this unusual straggler to the North Atlantic. The value of the present essay is enhanced by the trouble which the writer has taken to make an abstract of our present knowledge of the distribution and breeding stations of this albatross. It is embellished by a beautiful photograph of the Stacks of Myggennaes, on which the bird was killed, reproduced from a negative secured by that talented photographer, Mr. W. Norrie.

THE CHINCH BUG.

THE "Chinch Bug," *Blissus leucopterus*, Say, is an insect which has long been notorious in the United States on account of its injuries to corn-crops. As it was first found in the Atlantic States, it has generally been believed to have travelled westwards, as fresh land came under cultivation by the farmer. In a recent discussion of its distibution (*Journ. Cincinnati Nat. Hist. Soc.*, xviii., p. 141) Mr. F. M. Webster brings forward evidence in support of the view that it has travelled northwards from the shores of the Gulf of Mexico, showing that its near allies inhabit Tropical America, and that it may well have subsisted on native grasses in the central States before the land was cultivated. An original maritime home for the insect is inferred from its habit of congregating in colonies at the roots of grasses in all stages, and choosing slight elevations for its breeding-places. The latter habit, presumably adopted for safety from floods or high tides, is still practised in the centre of the continent.

I.

Casual Thoughts on Museums.

Part IV.[1]—The Zoological Department of the British Museum.

EVERYBODY knows that all well-regulated houses contain a cupboard in which there is a skeleton, but it does not seem to strike people, especially those who live in museums, that cupboards are the most suitable and proper places for the majority of skeletons to be housed in. A room full of skeletons is not the place for the student in search of sweetness and light, and what it is supposed to teach no one quite knows. If we are to compare bones and thus to discriminate between different forms, it is no use having them articulated. The student who is advanced enough to appreciate these distinctions will learn little or nothing from bones linked together by iron wire, while the casual visitor, who ought to be taught that a skeleton is the necessary scaffolding upon which every animal is moulded, ought, if he is to learn anything, to see the skeleton in juxtaposition with the stuffed skin and with some of the soft parts.

Under any circumstances, if skeletons are to be exhibited, it seems monstrous to separate entirely the recent and the fossil ones. The replacement of gelatine by carbonate of lime is not a process confined to buried bones, as my own gouty fingers tell me.

For these several reasons, everyone will welcome the change contemplated by Sir William Flower, by which the Dead-House in the upper storey of the Natural History Museum is no longer to furnish subjects for nightmares to nurses and children, and this very fine exhibition gallery is to be devoted to a much more sensible show. It is to be hoped that a large proportion of the skeletons will be duly placed in cupboards and the rest distributed between the galleries containing the stuffed animals and those containing the fossil ones.

I will venture a few words about each of these departments and the function exhibited skeletons ought to fulfil in them. *In limine*, let me give one more groan over the almost criminal folly and obstinacy by which the Museum was so planned that, while the fossil beasts are on the ground floor, the stuffed ones are upstairs, the whole logical sequence of the arrangement being inverted. The expense and trouble of changing the plan are so great as to make it almost

[1] For Parts I., II., and III. *see* Natural Science, vol. vii., pp. 97 and 319, and vol. viii., p. 114.

impossible to contemplate, so that it promises to remain a remarkable monument to someone. It is said the excuse for this absurdity was that the cases which could alone be accommodated downstairs were not sufficiently high, it being thought that, like the giraffe, the British youth and maiden could easily study objects placed at eight and ten feet from the ground. I see that Mr. Lydekker is sensibly closing the upper cases in the Mammalia Room, and filling the fronts in with maps and diagrams.

The revolution that is going on in this room is most welcome, and proves what a special genius for museum arrangement Sir William Flower possesses. Instead of a gallery filled with ill-shaped horrors three or four deep in the cases, and arranged without any order, and with inadequate and childish labels, the collection will soon be an unrivalled school for teaching this branch of natural history, not merely to children, but to Members of Parliament and other half-educated people. The portion already arranged by Mr. Lydekker is simply first-rate; the peculiarities which mark off each genus or family are plainly shown either by whole skeletons or portions of critical importance; the stuffed specimens really look as if they had once belonged to living animals, only specimens that teach something are exhibited, and they are arranged in sequence, beginning with the monotremes and ending with monkeys, while the labels are an epitome of what ought to be known by educated people on the subject. One thing only I would complain of in these labels. Every Latin or Greek technical term other than a specific name ought to be accompanied by a translation in a museum meant for everybody.

It will not, I hope, be thought impertinent if some suggestions are offered while the work is progressing. If it were possible, it would certainly be a gain to a large number of ignorant people to show what food the animals live upon, whether they frequent deserts or otherwise, whether the young are in a helpless condition or matured when born; in the case of the kangaroos, the antelopes, chamois, etc., to show their mode of progression by leaps, etc. Let an effort, too, be made to secure, if possible, at least one adult specimen of the African and of the Indian elephant—surely no museum of first-rate importance in the world except this is so poor as not to be able to show at least one adult elephant.[1] A new specimen of the giraffe less damaged by time would be very welcome, and lastly, to meet the demands of those who love beautiful objects, as well as bloodthirsty boys and sportsmen, let us have some well-mounted groups of the Carnivora. Daniel would have preserved his self-possession unscathed among lions like some of these.

All these things will no doubt come—in fact, they are coming quickly—for we have great faith in the "Panjandrum" of museum

[1] Since this paragraph was written, the great Asiatic Elephant at the Zoo has died, and we are glad to say its skin is presently to be set up in the Mammal Gallery.

arrangement, and we sincerely hope he may have a long lease of power, and plenty of strength in his elbow, as he certainly has a loyal staff determined to help him.

As is well known, what has been done for the mammals is also being done for the birds, and I doubt whether anything so instructive to the ornithologist has ever been shown in any museum as the case illustrating the arrangement and the economy of the woodpeckers, a scheme which is now being applied to the humming-birds. Here, again, occasional skeletons are judiciously employed, and also preparations of the soft parts, which mark off and distinguish classes, etc., and the tyro in systematic zoology is taught the principle underlying scientific arrangement.

One thing I would plead for very hard. There are rumours that possibly the special collection of British animals will be done away with, or distributed in the general series—this would be a serious disaster for the great bulk of visitors who go to the museum for some other purpose than flirtation or catching flies. The natural history of these realms is a subject of prime importance to the school-boy, the collector, the curator of the local museum, the sportsman, the field naturalist who cannot afford to travel—these crowd to the museum to see what they know best, namely, our English fauna and flora. If these English specimens are distributed in the general collection, they will be entirely lost to the special class of students just named, and besides it is a great gain, apart from the general systematic arrangement, to show a sample of a zoological province on a small scale, and it would be well to bring together in one gallery the beautiful and dramatic series of stuffed British birds, and thus to make room for similar groups of foreign, and especially of tropical, birds, showing them with their proper surroundings in the general Ornithological Gallery.

When this is done, or, still better, as soon as possible, let us be rid at all hazards of that ridiculous collection of cottage-window cases in which Gould put his humming-birds when he wanted to make a special show at the great Exhibition. They are literally absurd, and remind one of the way in which the Hindoo ornaments his curtains with green and golden beetles. A case of humming-birds, well stuffed and arranged, with models of the flowers among which they live, would be very welcome; but the great national museum ought not to house mere specimens of the bonnet-maker's style of taxidermy. By the way, taxidermy is a fine art, and it would become a finer art still if the true artist who sometimes produces an artistic effect were to have his name commemorated on the cases as well as the ingenuous and lucky gentleman who happened to give one out of twenty names to some wild animal not at all anxious for notoriety.

I have perpetrated enough impertinence for one number of your Journal. If I put in any more, people may think I belong to the staff.

HENRY H. HOWORTH.

597.
591.49

II.

The Teeth of Fishes.

THE calcified teeth of vertebrated animals bear no morphological relation to any of the heterogeneous structures called teeth that occur in invertebrates, but have been evolved within the confines of the vertebrate group. The low position which fishes occupy in the vertebrate series renders the study of their dentition of the greatest interest, because it is among them that the first evolution of such teeth originated. Vertebrate teeth are not new structures, *sui generis*, and independently developed, but have arisen by a modification of tegumentary or dermal organs; and nowhere is this fact more clearly demonstrable than in fishes. A comparison, under the microscope, of vertical sections of the teeth of the jaw with the placoid spines of the skin of the skate or dogfish, shows that the teeth are formed on the same fundamental plan as the spines, and are made up of the same essential tissues. In the young dogfish, shortly before hatching, there is no lip, and the spines which clothe the skin form a continuous series with those embedded in the mucous membrane covering the jaw. It is only when the lips develop that the continuity is interrupted, and the differences between the teeth and spines become more marked. The teeth then increase in size and solidity, and acquire their specific characters, whereas the spines on the exterior of the body remain practically unchanged.

Structure.—The three tooth-tissues, dentine, enamel, and cement, are represented in the teeth of fishes, the first, as usual, occurring in greatest bulk. The dentine is usually deposited uniformly around a conical pulp by the activity of a superficial layer of "odontoblast" cells; and the dentinal tubules, occupied by delicate fibrils proceeding from these cells, are arranged at right angles to the surface of the cone. Blood-vessels do not penetrate into the dentine, and its texture is consequently dense. In a few cases, *e.g.*, *Lepidosteus*, the surface of the pulp cone is fluted at the base, and the form of the dentinal covering is modified accordingly, so that a transverse section shows the dentine thrown into radiating plications or folds.[1]

[1] The complex pattern of the section of the tooth of some of the extinct Labyrinthodont Amphibia is hardly more than a further elaboration of this form of plication.

In the teeth of the eagle-ray (*Myliobatis*) and in the rostral teeth of the saw-fish (*Pristis*), the pulp is broken up into a great number of delicate parallel columns, around which the dentine is regularly deposited. A transverse section through the middle of such a tooth exhibits numerous radiating dentinal systems, each about what appears to be a separate pulp; but a section taken nearer the base shows how these pulp-columns unite below into a common pulp-mass.[1]

Besides this hard dentine, traversed by fine protoplasmic fibrils, there is another kind, termed *vasodentine*, in which dentinal tubules cannot be distinguished, but through which numerous irregular blood-capillaries ramify (Fig. 1, *vd.*). The minute structure of this dentine is much coarser than that of the former (Fig. 2, *d.*), and when, as frequently happens in fishes, the two kinds occur in the same tooth, it is the vasodentine which is internal and in closer relation with the pulp. A third kind, called *osteodentine*, bears a closer resemblance to bone than the two foregoing varieties of dentine. It is not developed entirely on the surface of the pulp, and is not related to an odonto-blast layer, but is deposited irregularly *within* the pulp. The channels and spaces of this form of tooth-tissue, therefore, differ from those of vasodentine, not only in their superior size, but in being occupied by pulp and not by capillary blood-vessels only (Fig. 2, *od.*).

The prismatic structure of the enamel is not well marked in the teeth of fishes, and this accounts for the relatively small number of cases in which its presence has been recognised. It is undoubtedly absent in some cases, *e.g.*, *Labrus*. Cement is of rare occurrence in fishes. A coarse form of cement, called by Tomes (9) 'bone of attachment,' serves in many cases to fix the tooth to the jaw; but since this substance is said to be developed from the bone of the jaw, and not from the tooth, it can hardly be regarded as the exact equivalent of the cement or 'crusta petrosa' which attains so great a development in the teeth of some mammals.

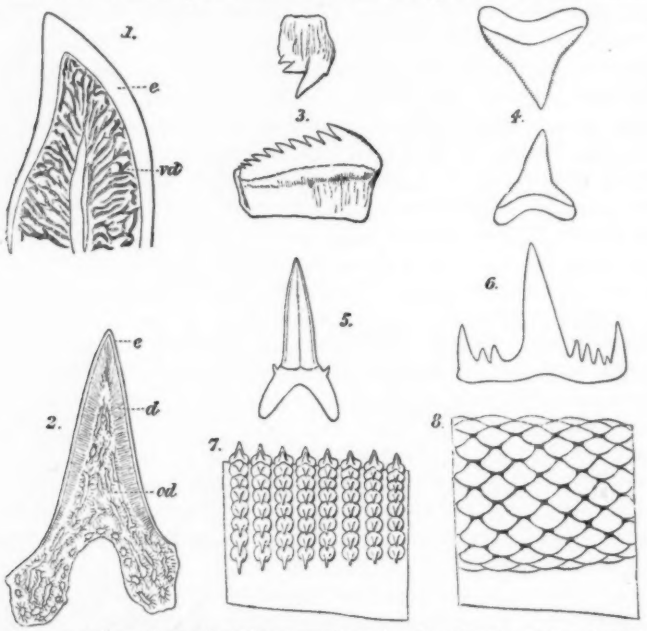
The teeth of Cyclostomata are epidermal in origin, and consist of hollow cones of a horny material belonging to the *stratum corneum* of the skin. In the hag-fish (*Myxine*), and in *Bdellostoma*, Beard (1) has shown that the dermal papilla develops an imperfect calcified tooth beneath the horny epidermal tooth.

Attachment.—Although teeth are structures developed entirely and solely from the mucous membrane covering the jaws, it is very commonly found that, in order to obtain that support which is necessary for the due performance of their function, the teeth acquire an intimate connection with the underlying skeletal parts. So accustomed are we, in fact, to this intimate relationship between tooth and bone, that we have come to regard the teeth as an essential of the jaw; and a skull from which the teeth have been lost we discard as imperfect. In the sharks and rays the teeth retain their

[1] A similar structure is presented, among Mammalia, in the teeth of the Cape ant-bear, *Orycteropus*.

primitive independence and are not directly connected with the jaws[1]; they are simply embedded in the tough fibrous gum (Fig. 9, *m*.).

Some teleostean fishes are provided with teeth which yield to pressure in a certain direction, and subsequently resume the upright position, by the elasticity of the ligament which attaches them to the jaw. In the angler (*Lophius*), in which these teeth acquire considerable size, the front of the base of each tooth is free, while, on the posterior side, dense fibrous ligaments radiate from the tooth to the bone of the jaw. The teeth, therefore, bend readily inwards towards the back of the mouth, but cannot be made to point outwards without



FIGS. 1 and 2.—Vertical sections, greatly enlarged, of teeth of *Cestracion* (1) and *Lamna* (2) (after Tomes), *d*, hard, unvascular dentine; *vd*, vasodentine; *od*, osteodentine; *e*, enamel. Fig. 3.—Upper and lower teeth of *Notidanus griseus*. Fig. 4.—Upper and lower teeth of *Carcharias lamia*. Fig. 5.—Tooth of *Odontaspis elegans*, Mid. Eocene. Fig. 6.—Tooth of *Cladodus striatus*, Lr. Carboniferous. Fig. 7.—Portion of lower jaw of skate, *Raia batis*, male, seen from behind. Fig. 8.—Portion of lower jaw of thornback, *Raia clavata*, female, from behind.

breaking the ligament. In the hinged teeth of the pike (*Esox*) the elasticity resides, not in the hinge proper, but in elastic fibres running from the osteodentine, that occupies the interior of the tooth, to the bone of the jaw.

[1] No true ossification takes place in the jaws of Elasmobranch fishes. A layer of calcified tesseræ is frequently found on the surface of the cartilage in the form of a crust, and in some extinct forms, *e.g.*, *Pleuracanthus* and *Cladodus*, as also in the recent *Aëtobatis*, *Myliobatis*, and *Rhinoptera*, the cartilage is permeated throughout by granular calcifications.

The commonest method of attachment of teeth to the jaw in bony fishes is by anchylosis. The calcified tooth-substance and the bone are in actual continuity, so that it is often difficult to distinguish the line of junction. The connection is effected by a cement-like substance, which is called by Tomes 'bone of attachment,' because it develops from the periosteum of the jaw rather than from the dental capsule. It is very coarse in texture, and full of irregular lacunæ: it is absorbed when the tooth falls, and is developed afresh for the next tooth that occupies the same position. Instances of anchylosed teeth are found in the pike, eel, haddock, and mackerel.

Implantation of teeth in sockets is somewhat rare among fishes, but examples occur of lodgment of teeth in complete alveoli, and of numerous approximations towards this condition. The tooth and bone are in organic continuity by means of a periosteal layer common to the tooth and the jaw; and this layer may remain uncalcified, so that the teeth can be pulled out of their sockets, as in some Characinoid fishes; or 'bone of attachment' may, except in young teeth, anchylose the tooth to the wall of its socket, *e.g.*, *Sphyræna*.

Form.—The greatest diversity of form is observable in the teeth of fishes; in fact, as Owen points out (3, p. 1), "the teeth of fishes offer more various and striking modifications than do those of any other class of animals." In the aberrant ocean shark, *Rhinodon*, the teeth have the form of small, closely set, slender pillars, standing out at right angles to the surface of the jaw; but in most sharks the teeth are far larger in proportion, and are more important as organs of prehension. They may have the form of pointed spines, circular in section as in *Scyllium*, or compressed parallel to the axis of the jaw, as in *Carcharias*. The edges of such trenchant compressed teeth may be smooth and keen, as in *Lamna*, or finely serrated as in *Carcharias* (Fig. 4), *Galeocerdo*, and *Hemipristis*. An accessory cusp or denticle may be present on either side of the base of the main spine, as in *Odontaspis* (Fig. 5); in the three-pronged teeth of *Chlamydoselache* these lateral cusps are nearly as long as the median spine, and in the extinct *Diplodus* considerably longer. Among extinct sharks, teeth with multiple denticles are not uncommon, as, for instance, in *Cladodus* (Fig. 6) and *Hybodus*. The lower teeth of *Notidanus* (Fig. 3), two species of which still survive, have several such denticles on the posterior side of the main cusp. No hard and fast line, however, can be drawn between serrations and accessory cusps, the difference being one of size only.

While, in the compressed teeth of recent sharks, the portion embedded in the gum lies nearly in the same plane as the part exposed, in mesozoic fishes, *e.g.*, *Hybodus*, the base is bent inwards, and forms an obtuse angle with the crown, and in sharks of palæozoic times, *e.g.*, *Cladodus*, the teeth are characterised by a broad horizontally-expanded base, set nearly at right angles to the crown (Woodward, 10). In the archaic shark, *Chlamydoselache*, of the Japan seas, the base

is as broadly expanded as in the palæozoic *Cladodus* (Röse, 8, p. 200, Fig. 7). Crushing teeth are not common in selachians, but are found in the Port Jackson shark (*Cestracion*) (Fig. 10). In batoids, flattened grinding teeth are of more frequent occurrence, and the examination of the dentition of such a series of forms as *Raia*, *Rhynchobatus*, *Rhinoptera polyodon*, *Rhinoptera javanica*, *Myliobatis*, and *Aëtobatis* will explain the relation that exists between the single row of bent dental bars in the latter genus and the more normal dentition of *Raia*, which, in all essential respects, is the same as that of the selachoid *Scyllium*. The crushing surface of the teeth of the Cretaceous *Ptychodus* is marked by a series of parallel ridges, while the margins are delicately granulate. A somewhat similar surface-ornamentation is to be seen in the living *Rhynchobatus*, although here the teeth are much smaller in size.

Considerable variety of form is also found in the teeth of the bony fishes. The commonest and most typical form of tooth is the conical. Blunted, button-shaped teeth, frequently approaching the hemispherical form, are found both in teleosteans, *e.g.*, *Pagrus*, and the extinct lepidosteoid fishes, *Lepidotus*, *Cœlodus*, *Gyrodus*, etc. Blade-shaped teeth occur in *Sphyræna*, and the teeth of the eel have the form of compressed cones set transversely to the axis of the jaw. In the chætodont fishes the teeth are very long and slender, and in some cases even flexible.

The forms of teeth occurring in the Cyclostomata, Holocephali, and Dipnoi are characteristic of these groups; but, since they are dealt with in other parts of this article, a special description of them here is unnecessary.

There are probably very few fishes in which all the teeth in the mouth are exactly similar in character. In sharks, the teeth near the symphysis of the jaws usually differ from those situated towards the articular region in being larger and more powerful; and those between these extremes form a graduating series, in which the differences between adjacent teeth are hardly perceptible. Not infrequently the upper and lower teeth differ in shape, as in *Notidanus* (Fig. 3), *Carcharias* (Fig. 4), and *Læmargus*. Only in a few instances can the term "heterodont" be applied to the dentition of fishes. In the Port Jackson shark, *Cestracion* (Fig. 10), among Elasmobranchii, and in the wolf-fish, *Anarrhichas*, among Teleostei, the front teeth are pointed and adapted for the seizure of food, while the hinder are flattened into powerful crushing organs. In such teleosteans as *Chrysophrys* and *Pagrus*, the hind teeth are more rounded than those in front, but the difference is less marked than in *Anarrhichas*. Sexual differences in the dentition are extremely rare, but striking instances occur in many species of *Raia*, where the teeth are sharply pointed in the male, but flattened in the female.

Succession.—In sharks and rays the teeth are embedded in the dense fibrous gum, and are arranged in rows parallel to the axis of

each jaw. The teeth which are situated upon the edge of the jaw are usually erect, while the rows which lie behind them, farther within the mouth, point backwards, and are more or less recumbent, not having yet come into full use. New teeth are continually being formed on the buccal surface of the jaw, beneath a protecting fold of the mucous membrane (Fig. 9, *m'*), which acts as a composite enamel organ, locally differentiated into the enamel organs of the individual teeth. The developing teeth increase in size and thickness as, by a continual, but gradual, sliding of the gum over the inner surface of the cartilage, and outwards over its border, they are brought to the edge of the jaw, where they become functional (Fig. 9). They are finally shed, and their place is taken by the rising teeth behind. Owen (4, p. 383), with that happy choice of metaphor which always

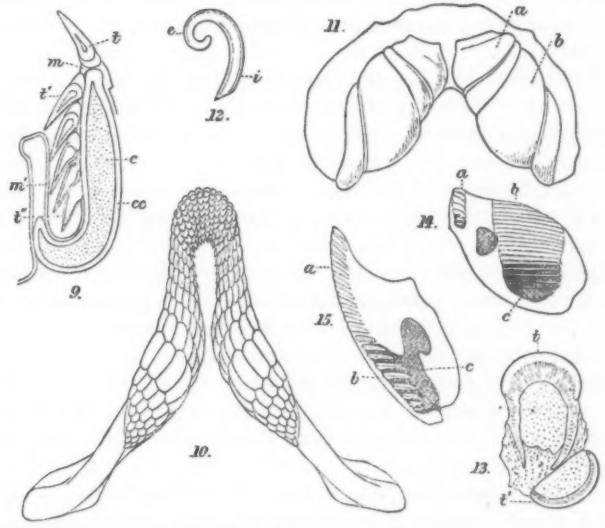


FIG. 9.—Transverse section through the jaw of *Carcharias*: *c*, cartilage of jaw; *cc*, its calcified crust; *m*, mucous membrane covering the jaw; *m'*, the fold of mucous membrane beneath which the young teeth develop; *t*, the tooth in use; *t'*, its successor; *t''*, the youngest tooth of the series. Fig. 10.—Upper jaw of *Cestracion philippi*. Fig. 11.—Lower jaw of *Cochliodus contortus*, Lr. Carb.: *a*, anterior dental plate; *b*, posterior do. Fig. 12.—Section of posterior dental plate of *Cochliodus*: *e*, external surface; *i*, internal or buccal surface. Fig. 13.—Vertical section through a tooth (*t*) of *Lepidotus maximus*, Kim. Clay, showing its successor (*t'*) in process of reversal (after Etheridge, *Q.J.G.S.*, xlv.). Fig. 14.—Section through the lower jaw of *Diodon*: *a*, marginal dental mass; *b*, second do.; *c*, alveolar cavity. Fig. 15.—Section through the lower jaw of *Scarus*: *a*, amalgamated teeth; *b*, younger teeth, still free; *c*, alveolar cavity.

characterised his teaching, describes the whole phalanx of teeth as ever marching slowly forwards over the border of the jaw, the front ranks, after having engaged in active service, being successively lost, while the rear ranks are continually being recruited by newly

developed teeth. In the skates (*e.g.*, *Raia*), and some dogfish (*e.g.*, *Scyllium*), and sharks (*e.g.*, *Odontaspis*), several rows of teeth are in use at a time; but in many sharks (*e.g.*, *Carcharias*, *Galeocerdo*), where the edge of the jaw is thinner, there is but a single row of functional teeth in each jaw. In the latter forms it is unusual to find adjacent teeth shed simultaneously. The replacement takes place alternately, so that there is never a large vacuity left in functional dentition. This provision against leaving any large extent of jaw unarmed is identical with that which is to be observed, with even more regular alternation, in the python, crocodile, and many other reptiles. In the jaw of the Greenland shark (*Læmargus*) the teeth overlap one another and interlock so closely that alternate succession is impossible. The successional teeth, therefore, rise together *en bloc*, and stand slightly higher than the older teeth. Seeing that the latter are not shed until some time after replacement, the dentition never for a moment loses its effectiveness.

The teeth of Holocephali and Dipnoi persist for life and grow continuously. These teeth are considered by Röse (7) to have originated by a fusion of separate tubular denticles, a view which is borne out by palæontology; but he unfortunately compares the teeth of Dipnoi with those of *Myliobatis*, the tubular structure of which is due to a sub-division of the pulp of the individual teeth (*see* p. 381). The horny teeth of Cyclostomata are vertically replaced. In the common lamprey, *Petromyzon*, as many as three hollow cones may be found superimposed, separated from one another by a soft white tissue, which, like the cones themselves, is epidermal in origin, and which is in marked contrast with the dark yellow or brown colour of the horny material of the teeth. Of these three cones, the external one (Fig. 17, *t*) is the tooth in use, and the other two (*t'* and *t''*) are replacing teeth. A reserve tooth is thus ready for use immediately its predecessor is shed.

In most bony fishes, where the teeth are numerous and closely packed, the succession is irregular (*e.g.*, cod). In those, however, where the teeth are less numerous, an alternate replacement, calculated to gain the same advantages as in *Carcharias*, may frequently be found (*e.g.*, *Thyrsites*). The succession of socketed teeth is usually vertical. The young tooth is formed at the side of the older one, but, by absorption of the base of the latter, comes to lie vertically below it, and ultimately occupies the same socket (*e.g.*, *Sphyræna*, *Chrysophrys*). A most perfect instance of vertical succession is seen in the pharyngeal teeth of the wrasse (Fig. 20). In the extinct lepidosteoid *Lepidotus*, the replacing tooth undergoes a complete inversion before it finally comes into position (5 and 6). When first formed it has its pulp-cavity directed towards that of the tooth which it will replace, while its crown points in the opposite direction. The tooth then gradually turns over (Fig. 13, *t'*), and by the time it supplants the old tooth it has turned through an angle of 180 degrees.

In teleostean fishes there are found a number of anomalous, composite tooth-structures, which have resulted from a modification of continuous succession. In the porcupine-, or globe-fish (*Diodon*), the upper and lower jaws are each provided with two complex structures of a dental nature. The one of these (Fig. 14, *a*) situated along the anterior border of the jaw, constitutes a blunt cutting edge, while the other (*b*), which is larger in size and situated farther back, presents an oval crushing surface. A section through the jaw shows that the dental organs consist of a great number of superposed plates of dentine, free when young and widely separated, but firmly and closely amalgamated by a bony cement when they approach the surface of the jaw to replace their predecessors which have been worn away. The obliquity of the grinding surface to the plane of the plates causes portions of several of these to be exposed at a time. In the parrot-fish (*Scarus*) the teeth are developed in great profusion in the interior of a large, common alveolar cavity in the bone of the jaw. The younger teeth (Fig. 15, *b*) are free, that is to say, they are held together only by the organic materials occupying the alveolar cavity; but the six or eight oldest teeth (*a*) of each vertical series are firmly bound together by a bony deposit. The teeth lie on their sides, and are piled up one above the other with their apices directed outwards, so that the biting surface is made up of the *sides* of the amalgamated teeth (Boas, 2).

Arrangement of Teeth in the Different Groups of Fishes.—In the lamprey (*Petromyzon*) the teeth are uniformly and symmetrically disposed over the surface of the suctorial disc. The teeth are mostly conical in form, but those in the centre of the mouth are larger and of a more complex shape (Fig. 16). In the hag-fish (*Myxine*) there are several sharp teeth arranged in four rows on the extremity of the lingual cartilage, but only a single tooth in the roof of the mouth.

Although in most sharks the largest teeth are to be found at the front of the jaw, in the Port Jackson shark (*Cestracion*) (Fig. 10) the front teeth are small and pointed, whereas the hinder teeth have the form of broad crushing plates, adapted for breaking the shells of the molluscs that constitute the food of this shark. Numerous examples of such a dentition are found in extinct sharks, *e.g.*, *Acrodus*, *Orodus*, etc. In *Pleuroplax* and *Pœcilodus* the crushing teeth tend to fuse into continuous plates, a form of coalescence which finds its culmination in *Cochliodus*. The individual crushing teeth are indistinguishable in *Cochliodus*, but each ramus of the jaw is provided with two spirally-coiled dental plates (Fig. 11, *a* and *b*). There is nothing equivalent to the shedding of teeth, but the disused external portion of the dental plate (Fig. 12, *e*) becomes buried in the edge of the jaw as the spiral revolves slowly outwards. In the skates and rays the dentigerous surface of the jaw is much more rounded than in the sharks, more rows of teeth are in use at a time, and the teeth are more closely set, with smaller intervals. In some forms the teeth are so blunt and so

closely packed as to form a dental mosaic or pavement, *e.g.*, *Rhinoptera*, and the eagle-ray, *Myliobatis*. The central tooth-plates are, in such cases, usually larger than the marginal plates, although this inequality is not apparent in the young. In *Aëtobatis* the central plates alone are present. Small denticles frequently occur embedded in the general mucous membrane of the mouth, and over the pharyngeal borders of the branchial arches, *e.g.*, *Galeus* and *Cestracion*. These denticles, being less specialised than the teeth of the jaw, bear a much closer resemblance to the placoid spines of the integument than do the teeth. In the basking-shark (*Selache*) long comb-like gill-rakers, said to be composed of dentine, project inwards from the branchial arches and act as strainers, preventing the escape, through the gill-clefts, of the small animals taken into the mouth as food. Very similar gill-rakers are found in the ganoid fish, *Polyodon*, and in some teleosteans, *e.g.*, the shad (*Clupea alosa*). In the saw-fish (*Pristis*), the prenasal rostrum is greatly elongated and armed with a series of strong teeth along each margin, in the form of a two-edged saw. The teeth are arranged at regular intervals, and are implanted in distinct sockets. They are not shed, but continue to grow from persistent pulps, and, if lost accidentally, they are not replaced.

No great development of teeth is to be found in the cartilaginous ganoids. The mouth of the sturgeon has the form of a protrusible suctorial tube, devoid of teeth; but true teeth are present in the larva (Fig. 18). In *Polyodon* the jaws are armed with numerous minute teeth, embedded in the mucous membrane, but not connected with the underlying bone. In the Dipnoi there are two pairs of large grinding teeth, one pair in the mandible (Fig. 19, *s*) anchylosed to the splenial bones, and the other pair (*p*) borne by the palato-pterygoid bones in the roof of the mouth. There is also a small pair, known as the vomerine teeth (*v*), situated in front of the palatine pair. These are not in relation with any of the bones of the skull, but are loosely fixed to the under surface of the ethmoidal cartilage. In *Ceratodus* the inner border of the large teeth, both upper and lower, is convex, and the outer edge is, in the living species (*C. forsteri*), marked by five deep notches. The two vomerine teeth have the form of plates in contact anteriorly, but diverging behind. The large teeth of *Ceratodus* were known in the fossil state long before the discovery of the existing species. In the ancient forms, *Ctenodus*, *Dipterus*, etc., the general build of the teeth is the same as in *Ceratodus*, but the complexity is greater. In *Protopterus* there are only two notches in each of the large teeth, and the vomerine teeth are slender and conical in shape. The palato-pterygoid teeth of the right and left sides are in contact in the median line, as are also the mandibular teeth; but this is not so in *Ceratodus*. The mandibular teeth are situated more anteriorly than in *Ceratodus*. The dentition of *Chimæra* bears a striking resemblance to that of the Dipnoi. The external borders of the teeth are not notched, but the mandibular teeth show a pair of broad shallow

grooves on their upper or buccal surface. The vomerine teeth in *Chimæra* are relatively larger and more important than in Dipnoi, and they touch and overlap the palato-pterygoid teeth.

In the osseous fishes (Teleostei and Ganoidei Holostei) the dental system is well developed, although exceptionally, as in the pipe-fish (*Sygnathus*) and sea-horse (*Hippocampus*), teeth may be altogether wanting. Teeth are usually present on the premaxilla and dentary, and frequently also on the vomer and palatine, and on the branchial arches. The maxilla, pterygoid, parasphenoid and splenial bones bear teeth in the Ganoidei; but in the Teleostei maxillary teeth are confined to the Physostomi, the pterygoid and parasphenoid bones

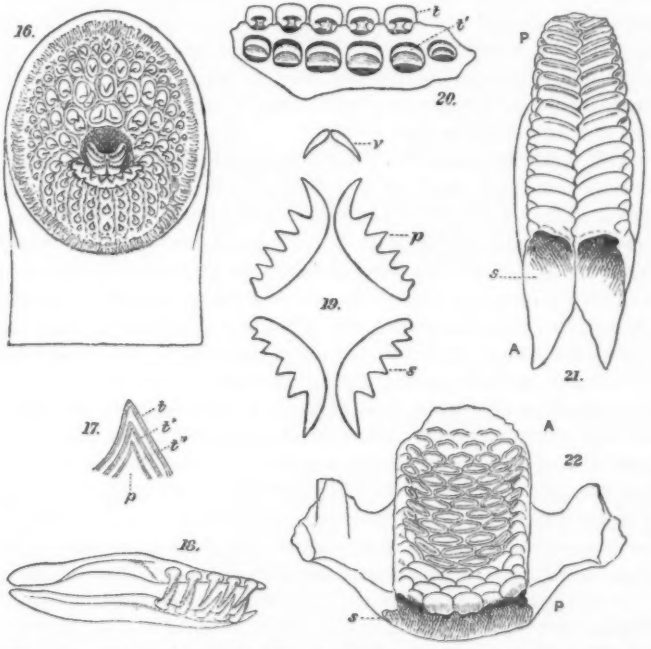


FIG. 16.—View of suctorial disc of the mouth of the lamprey, *Petromyzon marinus*. Fig. 17.—Section, greatly enlarged, of a tooth, *t*, of the lamprey, with its two successors, *t'* and *t''*; *p*, the dental papilla. Fig. 18.—Upper and lower jaws, greatly enlarged, of the larva of the sterlet, *Acipenser ruthenus* (after Parker, *Phil. Trans.*, 1882). Fig. 19.—Teeth of *Ceratodus forsteri*: *v*, vomerine; *p*, palatopterygoid; *s*, splenial teeth. Fig. 20.—Section of a portion of the pharyngeal bone of *Labrus* (after Owen): *t*, tooth in use; *t'*, its successor. Figs. 21 and 22.—The upper (21) and lower (22) pharyngeal bones of *Scarus muricatus*: A, anterior end; P, posterior end; *s*, space occupied by developing teeth which have not yet coalesced or become adherent to the bone.

are only exceptionally dentigerous, *e.g.*, *Elops* and *Albula*, and splenial teeth do not occur at all. In the living bony Ganoidei all the bones related to the mucous membrane of the mouth are richly beset with

teeth, but in the Teleostei, where these bones are more deeply placed, the teeth are more restricted in their distribution. It is only in the most lowly organised forms, *e.g.*, *Albula*, that a more uniform distribution of teeth, at all approaching that which occurs in the Ganoidei, is to be observed. Teeth are very extensively developed on the palatine bones in the pike (*Esox*), but in a great number of Teleostei, *e.g.*, the cod (*Gadus*), the palatines are edentulous. The exceptional dentitions of *Diodon* and *Scarus* have already been alluded to (p. 387). The dentition of *Tetrodon* is essentially similar to that of *Diodon*, except that only the marginal set of tooth-plates is present. *Triodon*, on the other hand, appears to be more related to the Scaroids, judging by the nature of its dental armature. In the file-fish (*Balistes*) the teeth are relatively large and are disposed in a double row in the premaxilla, and a single row in the dentary. In *Thyrsites* and *Sphyræna* the teeth at the front of the premaxilla are very large in size and are backwardly directed, in a manner recalling the disposition of the poison fangs in a venomous snake.

Gill-teeth, developed on the pharyngeal margins of the branchial arches, are usually small in size and thickly set (*e.g.*, pike). They may be united by their bases into small plates, but the plates are merely embedded in the mucous membrane, and are not united to the bone. In the sun-fish (*Orthagoriscus*) the gill-teeth are enormously developed. They are elongated and sharply pointed and are anchylosed to the branchial skeleton. The carp (*Cyprinus*) is edentulous so far as the mouth proper is concerned, but the two lower pharyngeal bones carry well-developed teeth, opposed to a callous tubercle projecting from the basioccipital bone. It may be taken as a general rule that the pharyngeal dentition is inversely proportional to the extent of tooth development on the jaws. In the wrasse (*Labrus*) the upper pharyngeal bones bear teeth as well as the lower. The teeth are of hemispherical shape and have a vertical succession (Fig. 20). The pharyngeal teeth of the extinct *Phyllodus* have the form of flattened, slightly convex plates. Underlying each of these is a series of five or six similar plates of the nature of reserve teeth. The older plates are not shed as a whole, but wear away in places, leaving the younger replacing teeth partially exposed. The pharyngeal teeth of the parrot-fish (*Scarus*) are compressed antero-posteriorly and are developed in common alveolar cavities (Figs. 21 and 22, *s*) situated at the posterior end of the lower and at the anterior end of the upper pharyngeal bones. The upper teeth therefore succeed one another in a backward, and the lower in a forward direction. The teeth are developed independently, but are firmly anchylosed to the bone and to one another before they come into active use. There is a close analogy, as Owen points out (4, p. 381), between the dental mass carried by the pharyngeal bones of *Scarus* and the complicated molar teeth of the elephant, both in form, structure, and in the reproduction of the component denticles in horizontal succession.

The substance of this article agrees, in the main, with the information supplied by the explanatory labels attached to a series of preparations, illustrating the dental system of fishes, recently added to Sir William Flower's educational collection, or "Index Museum," in the entrance hall of the Natural History Museum. My grateful acknowledgments are due to Sir William Flower for kindly permitting the reproduction of several of the specimens to illustrate this paper.

REFERENCES.

1. **Beard, J.**—"The Nature of the Teeth of the Marsipobranch Fishes." *Zool. Jahrb. Anat.* Bd. iii., pp. 727–752; 1889.
2. **Boas, J. E.**—"Die Zähne der Scaroiden." *Zeitschr. wiss. Zool.*, xxxii., pp. 189–215; 1879.
3. **Owen, R.**—"Odontography." 1840–5.
4. ————.—"Anatomy of Vertebrates." Vol. i.; 1866.
5. **Pictet, F., et Jaccard, A.**—"Reptiles et Poissons fossiles du Jura Neuchatelois." Matériaux pour la Paléontologie Suisse, ser. iii., i., pp. 35–41, 1860.
6. **Quenstedt, F. A.**—"Ueber einen Schnaitheimer Lepidotus-kiefer." *Württemb. Jahreshefte.* Jahrg. ix., pp. 361–365. 1853.
7. **Röse, C.**—"Über Zahnbau und Zahnwechsel der Dipnoer." *Anat. Anzeiger*, vii., pp. 821–839; 1892.
8. ————.—"Über die Zahnentwickelung von *Chlamydoselachus anguineus*." *Morph. Arbeiten.* Bd. iv., pp. 193–206; 1895.
9. **Tomes, C. S.**—"Dental Anatomy." Ed. 3; 1889.
10. **Woodward, A. S.**—Brit. Mus. Cat. Fossil Fishes, pt. i., p. xxii.; 1889.

The following papers, not referred to in the text, may also be consulted with advantage by students desiring further information on the subject:—

Beard, J.—"The Teeth of Myxinoid Fishes." *Anat. Anzeiger.*, vol. iii., p. 169–172; 1888.

Carlsson, A.—"Über die Zahnentwickelung bei einigen Knochenfischen." *Zool. Jahrb. Anat.* Bd. viii., pp. 217–244; 1894.

Giebel, C. G.—Odontographie. 1855.

Heincke, F.—"Untersuchungen über die Zähne niederer Wirbelthiere." *Zeitschr. wiss. Zool.*; vol. xxiii., pp. 495–591; 1873.

Hertwig, O.—"Über Bau und Entwickelung der Placoidschuppen und der Zähne der Selachier." *Jenaische Zeit.* Bd. viii., pp. 331–404; 1874.

Hoppe.—"Untersuchungen über den Kauapparat des Cyprinoiden *Leuciscus rutilus*." *Deutsche Monatsschr. Zahnheilkunde*; Feb., 1895.

Jäkel, O.—"Über die Gattung Pristiophorus." *Archiv f. Naturgeschichte*; Jahrg. lvii., Bd. i., Heft i., pp. 18–26; 1891.

Mummery, J. H.—"Some Points in the Structure and Development of Dentine." *Phil. Trans.*, vol. clxxxii., pp. 527–545; 1892.

Röse, C.—"Über die Zahnentwickelung der Fische." *Anat. Anzeiger.*, Bd. ix., p. 653–662; 1894.

Scott, W. B.—"On the Development of Teeth in the Lamprey." *Science*, vol. ii., pp. 731–732; 1883.

Tomes, C. S.—"On the Development of the Teeth of Fishes." *Phil. Trans.*, vol. clxvi., pp. 257–267; 1876.

Woodward, A. S.—"The Evolution of Sharks' Teeth." NATURAL SCIENCE, vol. i., p. 671; 1892.

W. G. RIDEWOOD.

597.8

III.

The Midwife Toad.

[Twenty specimens of the curious batrachian, *Alytes obstetricans*, having recently been purchased for the Zoological Gardens, London, we have induced Mr. Hartmann, who supplied the animals, and who has made an exhaustive study of their habits, to furnish us with the following account of his observations. Mr. Hartmann is ready, not only to supply further specimens, but to act as guide to any zoologist who would like to observe the animals in their native haunts.

The genus *Alytes*, we may remind readers of this article, belongs to the ancient family Pelobatidæ, which is in some respects intermediate between the Ranidæ (Frogs) and the Bufonidæ (Toads). In the presence of teeth on the upper jaw, they resemble frogs. In the more important character of overlapping ends of the coracoids, the thick body, the coarse, glandular skin, the short limbs, and in their habit of laying the eggs in strings, they resemble toads.—Ed. Nat. Sci.]

THE German name for the animal, of which I am about to tell English-speaking friends of terraria and their inhabitants, is not beautiful—"Geburtshelferkröte." In English natural history it has an equivalent name "Midwife Toad." In sundry works on natural history, the names "Fessler" (lit. "chainer") or "Höhlenkröte" ("toad-in-the-hole") are also found. These names, however, do not express the curious characteristics of the creatures, as does the first-mentioned. The midwife toad occurs only in hilly ground, where clear, perpetual springs are found, as in the Black Forest, the Vosges, Taunus, Ahrthal, Siegthal, Wupperthal, and in the Harz and Sauerland. In France, whence the animal appears to have come into Germany, it is to be met with in the neighbourhood of Paris.

From the middle of March, so soon as the snow no longer covers the fields, till August, in the evening as dusk comes on, the call of the male, which is like a soft bell, can be heard in the places where they live. Each individual has a different note, so that there is no monotony; on the contrary, the calls are like a distant melodious chime. If you approach, the creature is silent, and retires creeping into its hole, where it sits till all is quiet; then it emerges again, and lets its bell-like note float into the air. Professor Landois writes, in his work "Animal Life of Westphalia," that this batrachian has indeed been

named "Glockenunke (Bell-frog) *Rana campanisona*" on account of its note. A person who does not know the creatures will not believe that it is they that can give forth such lovely tones.

At the call of the male the little female comes out. When a pair are met, the male clasps the female with his forelegs in such a way that, with the aid of the hindlegs, the egg-cord is drawn out of the cloaca of the female; thereupon the male fertilises the eggs and winds the cord, containing about 200 eggs, in the shape of an 8 round its hindlegs, putting a leg in each loop of the 8. Now the pair let go; the female has done its duty and is free, while the male alone undertakes the care for the future. With this "sweet" burden it hops and creeps about, seeks food, and pipes its note to its comrade. The burden does not seem to inconvenience the little creature in the least. About three weeks later it jumps all at once into the water, struggles out of the egg-cord, and begins again its terrestrial existence. So soon as the eggs reach the water, their tense covering softens, and, through the movements of the buried but visible creature within, it splits, and the young larva disports itself gaily in the new element, its second home, till, grown into a toad, it also seeks the land, to live by day in a hole, and to creep out at night in search of a fat slug, or some other dainty morsel. To my personal knowledge, all tadpoles winter in the water, so that the creatures are never fully developed in one summer. They may also be completely frozen without any injurious effects. This I have seen, not only during the severe winter on my daily walks to the spots where they are found, but also among the twenty larvæ which I have harboured since last July in my aquarium. During the severe cold of last February I moved from Barmen to Münster. My aquarium was for seventy-two hours in a furniture van, with the result that the water in it was frozen through and through, and arrived here a solid piece of ice, in which the beetles, gold-fish, and *Alytes* larvæ could be seen lying. When brought into a warm room the ice took seventy-two hours to melt; one larva after another got free and hurried merrily about. They are still all living and are beginning to develop into adults. I may mention that the imprisonment in the ice was also not detrimental to the water-beetles and goldfish, but all my toads, which made the same journey in a terrarium, were frozen to death.

The larvæ subsist on carrion and the corpses of any animals in the water: thus they gnaw a frog or a triton to the bone. They lick the plants and slide their mouth against the stones and glass walls, whence one may conclude that they also like the delicate slime as food. In colour the larvæ are like the adults—olive-green, mixed with brown—but there are some which shade into a yellow. The belly is yellowish-white towards the head, verging towards the anus into rose, with which the throat also is speckled. The back is covered with warts, which are especially prominent at the junction of the belly and the back. The backs of the larvæ are quite smooth.

The little creatures do not lose their tail till they come on land. In great numbers they leave the water from May till September, and hide themselves under neighbouring stones, where they sit huddled together till dusk, when they begin the march to the fields in which they desire to spend their lives. To attain sexual maturity they need three years. Though I have handled more than 1,000 *Alytes*, I could discover no outward sexual differences.

The toads sit the whole day in hollows which they have dug out, and which look like mouse-holes slightly flattened, or under stones in old quarries. The drier and hotter the weather, the deeper they bury themselves. They seem to need damp earth, though they only use the water to throw off their eggs. They do not jump very often, but sit in front of their holes, and lie in wait for a slug, a fly, a worm, or similar insect, so that in case of danger they can retire into their holes. If they spring unsuccessfully after an insect they turn their backs on it, just as though they would not show their anger to a mere food-creature. If they swallow it only half, or if it is too large for a single bite, they aid themselves with the right or left leg, blink their eyes, lick their jaws again, and resume their look-out. Three years ago I had so tamed a toad that it ate a wriggling worm which I held out in my hand. It is interesting to watch how the toes of the fore-feet tremble when the toad discovers an insect, how it slowly advances in order to make a sure spring, and what exertions it makes with the whole body to get a stalk or a stone out of its mouth again, which, in the eagerness of the skirmish, it has also snapped up. Young animals, which have chosen too large a worm as food, are overthrown by its twisting and wriggling, and have to let it go again.

One often finds egg-cords lying about loose. Presumably the male, in squeezing into too small a hole, has rubbed them off, or even lost them in a fight. In the holes I have found twelve toads lying next to, over and under, each other. If exposed suddenly, so that daylight strikes them, they appear to want to creep into themselves without hopping away. In the day, however, one can only catch them by digging them out with a spade. In the evening one must slowly creep to the place whence the song issues, taking a dark lantern. Its colour shields the toad well from danger, for a damp stone covered with very fine moss has just the same appearance. The eyes, with perpendicularly-cut black pupil and golden iris, stand out of the head. The forefeet, on which are four toes, bend quite inward, so that they can be used for the excavation of holes.

Münster, Westphalia. CARL HARTMANN.

591.34

IV.

The Meaning of Metamorphosis.

AN article in *Nature* for December 19, 1895, on "The Transformations of Insects," by Professor L. C. Miall, is so obviously the result of a prolonged consideration of this subject by a gentleman who is well-known for his labours in the field of entomology, and is so important, that it does not seem to us advisable to allow the views brought forward to pass without some marks of dissent from those that hold opinions either partly or wholly distinct from his.

It is certainly very much to Professor Miall's credit, and of essential service to the advancement of science, that he has taken up this department of research, which, as he correctly states, has been much neglected by entomologists. It is, nevertheless, to be regretted that he has confined his reading before publication to the few works that he mentions, and has consequently not given a complete view of this field of research from a historic standpoint.

Professor Miall would doubtless have given more consideration to the opinions of other investigators than those who received their inspiration from Darwin's "Origin of Species," and his own researches would have been made more complete, so far as their explanatory hypotheses were concerned, if the possibilities of theories having another origin had been admitted and discussed.

This author's assertion "that the metamorphoses of insects are fundamentally unlike the transformations of polyps, echinoderms, molluscs, and crustaceans" is founded upon the idea that insect larvæ of the so-called higher orders often have resemblances to the adults of more generalised types, such as Thysanura, and on the fact that they pass through their transformations more slowly, these lasting to the sudden and late production of the winged imago or adult.

There are among insects, as in other branches of the animal kingdom, notable differences in the metamorphoses passed through by individuals belonging to different grades of forms. That these are more remarkable among the more specialised insects, and much more noticeable there than among the primitive forms, goes without saying. This matter has been treated of in the little book "Insecta," written by the authors of this paper, and there the distinction between direct (incomplete metamorphosis) development of the first nine orders of

Insecta, viz., Thysanura, Ephemeroptera, Odonata, Plecoptera, Platyptera, Dermaptera, Orthoptera, Thysanoptera, Hemiptera, is contrasted with the indirect (complete metamorphosis) development of the remaining seven orders, viz., Coleoptera, Neuroptera, Mecoptera, Trichoptera, Lepidoptera, Hymenoptera, and Diptera. The development of the individual in the first nine orders does not differ materially from that of animals in other branches of the animal kingdom which also have direct development. The fact that the larvæ resemble the adults of the more primitive Thysanura is parallelled by many similar cases in the animal kingdom. It is the usual rule that the younger stages of more specialised forms resemble the adults of the more primitive forms of the same stock, and this principle, discovered by Von Baer and Louis Agassiz, is the foundation of all systematic researches in phylogeny. Such resemblances have been traced between batrachians and fishes, especially by Huxley, among the fishes themselves by Agassiz, by Beecher among corals, trilobites, and Brachiopoda, by Jackson in Pelecypoda and Echinodermata, and by several authors, including one of the signers of this article, among Cephalopoda. Mr. Miall compares the batrachians with insects as a more nearly parallel type, but in this is there not some confusion? The comparison can only be made with those forms of insects having direct development. The batrachian has no quiescent stage, occurring subsequently to an active voracious larval stage, which last has provided by overfeeding for the existence and development of a pupa-like resting stage. In the insects and batrachians he introduces the term "adult transformations" for the later changes in which the pupa changes into the imago and the tadpole into the frog. Mr. Miall thinks, because the frog and the winged form are new and comparatively late additions to the primitive forms represented by the tadpole or the pupa, that the incoming of these stages should be called "adult transformation" or adult metamorphosis.

The trouble that one has in adopting this term arises from the general conception of the adult. This latter term is usually applied to the sexually matured individual, and in "Bioplastology and the Related Branches of Scientific Research"[1] one of the authors of this paper has endeavoured to define this stage more or less, and also other stages of the life of the individual. According to the nomenclature there devised, and supposed to be natural, adult changes of structure or characteristics, designated as sub-stages, are not confined to insects, but occur in all animals, and are found equally in their old age. The term "metamorphosis," however, in a technical sense, can hardly be applied to these sub-stages. The life of the individual can be divided and classified as follows, either in man or any of the invertebrates, although in some animals whose existence is dependent upon seasonal changes, *e.g.*, Lepidoptera, it is questionable whether

[1] HYATT: *Proc. Boston Soc. Nat. Hist.*, xxvi., pp. 59–125; 1893.

there is any distinct old age, and in very primitive forms also the marks of decline in the ontogeny may not exist, or may be difficult of observation, *e.g.*, Orthoceratidæ and the like.

TABLE OF ONTOGENIC TERMS.

Structural Conditions.	Stages.	Stages.	Sub-stages.	Sub-stages.
	Embryonic	Embryonic	Several	No popular names.
Anaplasis (Haeckel)	Larval or young	Nepionic	ananepionic metanepionic paranepionic	
	Immature or adolescent	Neanic	ananeanic metaneanic paraneanic	
Metaplasis (Haeckel)	Mature or adult	Ephebic	anephebic metephebic parephebic	
Paraplasis	Senile or old	Gerontic	anagerontic metagerontic paragerontic	

It will, of course, be understood that the artificial sub-division of each stage into three sub-stages is merely a matter of convenience. In our own experience, we sometimes find only two, and sometimes more than three, sub-stages, but in a large number of cases all the changes within any one stage may be described under three headings.

It does not appear that the epembryonic (postembryonic) changes taking place in the earlier life-histories of the first nine orders of Insecta, and classifiable under the term of direct development, can in any way be separated from those of other animals. The wings are not introduced suddenly in the Orthoptera, for example, nor, for that matter, in any other orders. Their development is strictly a phenomenon accompanying the nepionic or neanic stages of insect development, and the last stage in the orders from x. to xvi. is the pupal stage. The unfolding of the wings, of course, takes place in the ephebic stage, but this is not a change in which new structures appear. Their expansion and hardening is a mechanical result of unfolding and use taking place in structures elaborated in the pupal stage and probably inherited from animals in which such structures arose more gradually and became hardened and shaped by usage in more prolonged substages of growth.[1]

[1] Mr. Alfred G. Mayer, who has been working up this and connected subjects among Lepidoptera, and whose researches are original and thorough, and accompanied by drawings that will, when published, demonstrate his discoveries, has, at our request, furnished us with the following note in support of the conclusion stated above, that the changes taking place in the development of the wings are not so sudden and startling as they appear to be :—

"In the Lepidoptera the rudiments of the wings have been found in very young larvæ, Landois having demonstrated them in larvæ only 4 mm. long. My own researches have shown that they occur in the second and third thoracic segments, and consist merely of thickened infolded portions of the hypodermis itself. The cells of the larval wings are very much crowded together, and are elongate spindle-shaped. When the larva changes into a pupa the wings expand to about sixty times

Professor Miall states that, "In the Amphibia which undergo transformation, the stage added to the life-history of the more primitive forms is not the tadpole, but the frog or toad." This, it seems to us, depends upon what part of the animal's life is taken as a point from which to view the preceding stages. We must remember that the tadpole represents a highly-modified stage of development, and that in this are concentrated many chapters of the evolution of the ancestry of this type among the fishes and gill-breathing batrachians. This abbreviation or concentration of adult characters has been termed acceleration by Cope and one of the authors of this paper, and has been made the subject of special researches conducted among Vertebrata and Invertebrata. The results have been formulated into a law lately designated, by one of the authors of this paper, as the law of Tachygenesis. In following out genetic series it has been ascertained that the successive species or genera do not repeat the characters of their ancestors in detail, but abbreviate or shorten them in accordance with definite laws of procedure. The characters first acquired during adult stages of ancestors are not inherited at the same age in descendants. The supposed tendency to inherit at the same age in closely approximated living descendants is misleading, because, when one examines series in time, one finds that inheritance at the same age is only true of nearly contemporaneous individuals, and not even generally true of any large number of these. In other words, even in members of the same species, if a series of these in time be followed, there is constantly expressed a tendency to inherit characteristics earlier than the age at which they first appeared in ancestors. The terminal or highly specialised members of series have also been found to skip ancestral stages altogether, and these cases are cited, often by high authority, as unaccountable examples of abbreviations, or falsifications of the embryological records, and also under other imaginative, subjective appellations, showing that these authors are using their fancy to eke out their knowledge of the facts. The abbreviations are really the direct inevitable result of the continued action of the law of tachygenesis.

One of the very best examples is the *Salamandra atra* of the Alps, which brings forth living young. The embryo really passes through its aquatic gill-bearing stage in the ovary, and may, as has been

their former area, and, as a consequence, the cells of their tissues flatten out, forming a pavement epithelium. The pupal wing, therefore, is derived directly from the hypodermis of the larva. Some of the hypodermic cells become modified in the pupa, and form the scales; others become elongated and bind the upper and lower layers of the bag-like wing together, so that when the insect emerges from the chrysalis, and the blood pressure within the wings causes them to expand, they are prevented from bulging out into balloon-shaped bags, and become the large, thin, flat organs of locomotion with which we are familiar. The area of the wing of the mature insect is more than five hundred times greater than that of the larva. The pigments of the scales are derived from the 'blood' or hæmolymph of the pupa.

"ALFRED G. MAYER, Cambridge, Mass., *February* 26, 1896."

demonstrated by Mademoiselle de Chauvin, be arrested in its development and made to re-adopt the aquatic existence and reproduce the aquatic breathing-organs of its ancestors. It is obvious, in this case, that the *Salamandra atra* is highly tachygenic in its development, and has greatly shortened up the gill-bearing larval stage necessarily passed in the water by the other species of salamanders that are neither so highly specialised nor so completely fitted for terrestrial existence. The same is true of the tree-frog of Martinique, *Hylodes martinicensis*, which passes its tadpole stage in the ovum, and is born as a true frog. Such examples as these show that the ephebic (adult) highly specialised, acquired characters which fitted these forms for living upon the land have become more important, and encroached upon the field occupied in the ontogeny by ancestral adaptive aquatic organs and tendencies, until finally these animals have ceased laying their ova in the water and become able to carry them within themselves until their inherited aquatic metamorphoses have been passed through.

This law has been lately explained by one of the authors of this paper as due to the prepotency of acquired characters in phylogeny. Acquired characters introduced late in life, and adaptive or suitable, are seized upon by heredity, acting according to the law of tachygenesis, and are necessarily repeated, if they appear at all, in a certain succession with relation to other characters of the ontogeny, and this succession is parallel with the modifications that have taken place in the evolution of the group to which the animal belongs. Thus, in each succeeding member of a series, the last or later acquired modifications necessarily take up space and time previously occupied in ontogenic development by ancestral characters inherited from more remote ancestors. Two things cannot occupy the same space, and, consequently, the latest acquired and most suitable characteristics press back upon and tend to obliterate those which have been acquired from more remote ancestors, and which usually lie between the embryo and the middle of the neanic stage—that is, in the larval and earlier adolescent sub-stages.

This is obviously a rational corollary of evolution by descent with modifications, but it was not founded upon mental processes by either of its authors. On the contrary, it was laboriously worked out in detail in different series of animals, and carefully grounded by minute observations. It does not seem to us that the earlier appearance of the ephebic characters of the true frog or salamander can be spoken of as "adult metamorphosis," although in these the latest acquired adaptive ephebic characters have undoubtedly encroached upon the period usually considered as the larval or tadpole stage, leaving merely a transient recapitulation of this condition. This term, however, seems more appropriate for tachygenic types of this kind than for any of the Insecta. The metamorphoses of the last are exactly the reverse of the process common in Amphibia, and

the comparatively prepotent, newly acquired, adaptive characters are first manifested in the nepionic and neanic stages instead of in adults, as in Amphibia.

The Insecta of the more specialised orders, x.–xvi., afford, next to some parasites, the most notable examples of this mode of evolution. Their larval or nepionic, and pupal or neanic, stages are prolonged at the expense of the ephebic, winged, stage, and the reasons for this prolongation are found in the great number of new features introduced into these stages of development in these orders as contrasted with those of the more primitive and, in large part, more ancient orders, i.–ix. The law of tachygenesis has been at work here, as in the former cases alluded to above, and it is shown in the encroachments of the adaptive characteristics of the caterpillar, grub, and maggot upon the inherited characters of the Thysanuran stage, which loses its ancestral characteristics, until in most cases they are either obsolete or recognisable with difficulty.

The habits and structures which have been evolved in different types for continuing the life of the individual through the winter occur only in animals likely to be injured or to perish if exposed without some defence, and vary from the horny coverings of the winter buds of fresh-water sponges, Bryozoa, and Crustacea, to the storage of provisions in sheltered places by land-animals, and even hibernation may perhaps be included under this head, since this is equally the result of inability to lead an active life under the rigorous conditions of extremes of temperature.

The old view that the larval stage arose as an adaptation acquired by the insect according to its surroundings, providing either a caterpillar, grub, or maggot, and that these lead necessarily to a more or less protracted quiescent pupa stage, in which the animal can pass through the dangerous time without feeding, is more easily supported than any other view. It is certainly more in accord with obvious facts than the view that this stage arose because it was essential to the good or success of the species in the struggle for existence, or some other equally obscure teleological cause; as, for example, that each individual ought to have a prolonged period of rest in which to elaborate its complex internal and external anatomy.

As a matter of fact, we do not see how the same argument can be applied to the Odonata or Orthoptera, whose structure is certainly very complex, and which, in their insectal peculiarities, are not so far behind the higher orders as to justify the assumption that their differences of structure must necessarily be provided for by modes of development that are so disproportionately complex. If this be met by the assertion that their wings are transparent and their ephebic organs materially simpler than those of the orders x.–xvi., how is it that Ephemeroptera and Platyptera, which are very highly specialised in the ephebic stage, have no quiescent stage which can be compared with the pupa, and yet the Coccidæ, among Hemiptera, have such

a stage, although the full-grown forms of this family are not usually considered as pre-eminently the most complex of the first series of orders?

Mr. Miall uses a purely Darwinian phraseology, in part of his paper, in speaking of the generally earlier transformations of the inhabitants of shallow seas as contrasted with the later occurring and supposed "adult transformations" of Amphibia and Insecta. "It is," he says, "often of advantage that there should be division of labour between the several stages of the life-history, and the functions of migration and growth may be allotted to special times of life instead of being carried on throughout." "Marine animals commonly produce far more eggs than insects. The risks of the shallow seas are so great that a small proportion only of the young animals come to maturity." That is to say, if we correctly understand the argument, the inference is that these differences between marine animals and the inhabitants of the fresh waters and land have arisen through natural selection. So also in the following:—"The more sluggish and sedentary the adult, the greater the activity we may expect to find in the larvæ. It is they that have to travel and find suitable quarters."

This appears to us as assuming as proved the question just now at issue in the world of science. Is a habit or a structure of any special advantage, and, if so, what effect has it upon the life of the species and the possible origin of varieties and other species? Can these structures have arisen from other causes than natural selection? Everything that is suitable must in one sense be advantageous, but the fact, that any structure is of advantage, does not prove that this is, or even may have been, the cause either of its suitability or of its origin or anterior existence. It is of advantage, and it is also extremely suitable to its surroundings, that a drop of rain is spherical, but both of these adjustments to the surroundings are the results of laws that govern the relations of fluids to the earth and its atmosphere.

Natural selection resting on the often unproved assumption of the advantage of this or that structure is, in most of its supposed applications, to our minds untrue, and when it is true it is a result and not a cause. For example, with reference to the last quotations from Professor Miall, a vast number of Protozoa are very active, and we are not aware that they have very sluggish young, nor yet that their methods of reproduction differ essentially, or that they produce young which are any less volatile than those borne of sedentary forms. It is true that Porifera, Hydrozoa, Actinozoa, Vermes, and most of the Invertebrata that are aquatic have numerous eggs and very active larvæ as compared with the parents; but it is also worth while to consider whether this may not be due to the fact that these all belong to groups having a certain structure which may have been acted upon in a certain way by their surroundings.

There are also exceptions to this rule even in these aquatic groups. Thus the fresh-water *Hydra* has very few ova; the Bryozoa do not appear to us to have an over-supply; the Mollusca, as a rule, although marine and rather sluggish, do not have very numerous ova or remarkably active larvæ, yet their highest specialised voracious, quick-moving forms, the squids and cuttle-fishes, have very active larvæ; the highly specialised Spatangoids, such as *Hemiaster cavernosus*, Ag., and *Aceste bellidifera*, Thomp., protect their young, and must have comparatively few of them; while most fishes have numerous ova, this is not the case with those that are viviparous or rear their young in pouches that can only take in a limited number, or in their gills. Professor Miall refers to this as tending to promote helplessness in the young, and seems to consider this has a relation of cause and effect, the helplessness being due to the fact that the parents are able to find them food and protection. Does not this statement again assume to answer a question awaiting strict investigation? Do not parental care and helplessness of the young appear simultaneously? Can the helplessness of the young of the kangaroo, for example, when transferred from the vagina of the female to the pouch, be due to such a cause? Obviously, it is a case of premature birth, or at any rate of birth at a time when the young could not possibly take care of itself, and it is difficult to imagine how this could be advantageous in the early history of this group or arise out of parental care. Professor Miall imagines that the sluggishness of the parent "promotes activity" in the young, and that activity in the parent has the opposite effect, and also, that the power of flight "favours a sedentary life in the larvæ, which is spared all effort in connection with the dispersal of the species, and can give its undivided attention to feeding."

Professor Miall sees that this explanation does not accord with the active larvæ of the winged forms of the orders i.–ix., and he endeavours to overcome this by the further assumption that the larvæ do not necessarily become degenerated until their self-helpfulness, "care and responsibility," are taken away from them by parental care. These statements are eminently true, but conflicting in spite of this explanation, and it still remains obvious that the power of flight in orders i.–ix. does not favour "a sedentary life in the larvæ" any more than it does among some birds and the bats, and the Mammalia generally. There is connection between parental care and the degeneration of larvæ, and there is still more between parental care and tachygenesis; nevertheless, it is extremely difficult, if not impracticable, to place either of these phenomena in the relation of cause and effect, or even to take the first steps towards proving that parental care antedated and might have caused tachygenesis. Tachygenesis occurs equally in animals that as a rule take no care of their young, as among echinoderms and fishes, and yet the highly tachygenic young of the more specialised forms are found nestling in

specialised trough-like ambulacral furrows among the former, or in special pouches, or in the gills of the latter.

Professor Miall's view as to the causes of degeneration of insect larvæ approaches very close to that taken by the authors of this paper some years since, but differs in that he assumes natural selection to have been one of the active factors. It seems to us that the correlations between the kind of food and the structures of the larvæ, whether degenerate or not, are obvious; and the fact that the food was directly supplied by the parent, or merely indirectly furnished by the location of the ova, is not in our opinion anything more than the expression of a habit which was not in any sense dependent upon the possession of wings nor yet upon the necessity of distributing the species in search of favourable fields. Some Coleoptera have active larvæ, as in Gyrinidæ, although the parents are themselves among the most restless of insects, and there are many examples of wingless females, incapable of any extended travel, which lay their eggs upon food-plants from which the larvæ never stir until the plant is destroyed. The example of the active larvæ of *Epicauta* and *Melöe* which forage for themselves, as do many parasitic larvæ, and hunt food and provide for their own development through several variable stages and metamorphoses, as well as the great activity and migratory capacity of the army-worm, among the larvæ of Lepidoptera, are not favourable to the view that there is any causative connection between the activity of the parent and the capacity for active life of the larvæ. They are, however, favourable to the hypothesis that traces obvious connection between the structures and habits of the larvæ and their surroundings.

The structural modifications of the larvæ are, so far as we can see, the direct products of their habits and surroundings, and that the former should be suitable, and therefore advantageous, is a necessary and inevitable result. This result, in our way of looking at the facts, seems to differ from the results of other physical causes acting upon inorganic bodies, only in being obscured by the complexity of organic structures and false mental habits of regarding them.

In other words, it is putting the cart before the horse to place advantage as a cause when it is, together with the struggle for existence (as first clearly stated by an eminent entomologist, Dr. A. S. Packard), the result of the evolution of organisms which has been directed and governed by other and more fundamental laws.

Boston, U.S.A. ALPHEUS HYATT.
J. M. ARMS.

591.102

V.

Verworn's "General Physiology."[1]

WHEREVER there be two or three physiologists and zoologists gathered together, the question of the scope and method of physiology is discussed. From modern habit, and from the special relation of physiology to medicine, the physiologist is accustomed to defend the position that physiology is best advanced by the study of higher animals. The zoologist, on the other hand, maintains that the simple functions and properties of protoplasm are less clearly revealed in higher animals on account of the specialisation of their tissues. To this the physiologist makes the ingenious retort that in simple creatures all the capacities of protoplasm are so united and confused that it is impossible to distinguish them: in *Amœba*, for instance, you cannot study nervous, or muscular, or excretory functions, because the three occur simultaneously in the same mass; while in man or the guinea-pig you have cells and tissues in which the nervous, excretory, and muscular qualities are isolated, or at least preponderate. In this treatise, Max Verworn is more inclined to the zoological view: taking the phenomena of life and the qualities of living material as his subject, he elucidates them by reference chiefly to simple organisms, distributing his attention almost equally between plants and animals. His treatise is not a text-book of physiology in the current sense of the term: in it you shall find no direct prolegomena to the study of medicine, but rather an examination of the fundamental phenomena of all living things. "A Treatise on General Biology" would be a title more consonant with the existing terminology of the sciences, and in this respect the dedication to the memory of Johannes Müller is noteworthy.

Since we regard this treatise as a biological production of the highest importance, and since we think that no biologist should neglect it, a general account of its scope is the best method of commending it to our readers. The first chapter, of 58 pages, gives an account of the development of physiology from the earliest times to the middle of this century—that is to say, practically, to the end of Johannes Müller's time of activity. The author then discusses the method of physiological inquiry, and after full treatment of

[1] "Allgemeine Physiologie." Ein Grundriss der Lehre vom Leben. Von Max Verworn. Pp. 584, with 268 illustrations. Jena: Gustav Fischer, 1895. Price 15 marks.

various physiological and psychological theories, including an excursus into metaphysics, he comes to the sane conclusion of Johannes Müller, that there is no special physiological method, but that all methods are right if they lead towards the goal. The goal is investigation of life; and chemistry and physics, anatomy and embryology, zoology and botany, mathematics and metaphysics, all must be pressed into the service.

The second chapter, 84 pages in length, treats of the living material. Noting first that living material occurs discretely in individual masses, Dr. Verworn discusses the conception of individuality. He dismisses, of course, the old view that indivisibility was the criterion of an individual, and comes to the definition that an organic individual is a single mass of living material, in a formation that is capable of maintaining independent existence. He discusses the various categories of individuality from cells to states, pointing out that the higher individuals are composed of colonies of the next lower grade, and distinguishing, although not with the felicity of Professor Patrick Geddes (in the Encyclopædia Britannica), between morphological and physiological individuality. He discusses Altmann's granular theory, but accepts the criticism that Altmann included among "bioblasts" structures of quite different morphological and physiological value. He regards the cell as the vital elementary organism, and proceeds to discuss its various forms and its organs, such as the nucleus and the centrosome, which he takes to be a specialised part of the nucleus, sometimes with an independent existence. Then follows an account of the morphology of the cell, and of the plastids, such as starch granules, that may be found in it, and of the physical structure of protoplasm. In the latter connection he follows Bütschli (*see* NATURAL SCIENCE, vol. ii., p. 31) in the main. Then comes a most careful account of the chemistry of protoplasm, and an ingenious summary of the differences between organic and inorganic matter, a comparison in which, however, we think he is inclined to insist more upon the differences than upon the identities between the two. His final summary, however, is sufficiently mechanical to disturb the most ardent vitalist. "The process of life," he says, "consists in the metabolism of albumens."

The third chapter, extending to 130 pages, treats of elementary vital phenomena. The first section of this deals with metabolism, and the author gives a good account of the different food-materials and methods of absorption found among plants and animals. He makes the curious slip of stating that plants absorb their gaseous food through the stomata; it has been shown clearly by many experiments that the main function of stomata is regulation of the transpiration of aqueous vapour; carbonic acid and oxygen are absorbed through the general surface of the leaf. He then treats of anabolism, dealing perhaps rather superficially with the stages between food-material and proteid; and of katabolism, where his

account of excretion and of the relations between secretion, excretion, and the formation of inter- and extra-cellular matrices is excellent. The second section of this chapter describes the phenomena of change of form, which Verworn, following Haeckel, regards as divisible into two separate, but mutually dependent, groups, the phylogenetic and ontogenetic series of changes. In these, heredity is the conservative force; adaptation, the changing factor. In a short discussion of heredity, he points out that Weismann has practically disproved the inheritance of acquired injuries, but that in our ignorance of the correlations between organs it would be almost impossible to prove the definite inheritance of acquired characters. Moreover, he would not expect that experiments, unless conducted through a very large series of generations, could be expected to give any definite results. In a similar short discussion of adaptation he points out the direct effect of environment in shaping an individual organism, and the effect of natural selection in changing the form in a phylogeny. Obviously, there was no space for a full treatment of problems so vast as heredity and adaptation, but the mere raising of them in appropriate places in the development of the subject is an enormous gain to the philosophical treatment.

Then follows a general discussion of ontogenetic change, of growth and reproduction, of cell-division, fertilisation, of ontogenetic changes in single-celled creatures, and of the general phenomena of ontogeny in Metazoa. Verworn does not attempt a condensed account of embryology, but merely specifies the general nature of the changes that take place, summing them up in the sentence: "Cell-division, equal and unequal, and coherence of the results of division, are the factors that determine the embryonic development of a specialised cell-community." It is perhaps to be regretted that no room was found for a discussion of modern criticisms of the cell-theory: there are, at least, suggestive parallels to be drawn between the uni-cellular development of, say, a *Vorticella* from a spore, and the shaping and moulding of a metazoon.

The last section of this chapter refers to what may be called the vital transformations of energy in living organisms. The author discusses in detail the activities of living creatures, their movements of all kinds, and their productions of light, heat, and electricity. To the physiologist, accustomed only to consideration of ciliary motion, protoplasmic motion, and muscular motion, the comprehensiveness of this section will come very pleasantly.

The fourth chapter, 60 pages, on the general conditions of life, seems to us the most attractive section of the whole volume. After a brief review of the positive and negative conditions of life, the author passes to a historical and critical treatment of theories of life and death, and of the definite facts upon which theories must be based. His discussion of ancient and modern theories of the origin of life and of known facts leads him to the plain conclusion that what we call

life is an ordinary and not a supernatural result of the development of our planet. We know life only by its qualities, and these qualities, one and all of them, are necessary results of the interaction between the chemical, physical, and morphological properties of the mixture we call protoplasm and the surrounding forces. Similarly his discussion of death leads to a plain conclusion: no definite material system, like a piece of protoplasm, no definite complex of activities like life, is immortal; in the whole world all that is immortal and eternal is elementary matter with its forces.

The fifth chapter, of 120 pages, is upon stimuli and stimulation, and perhaps is the most directly interesting to physiologists. After treating of the nature of stimulation, the author deals with the mechanism of the different kinds of stimulation, in this following rather more closely than is his wont the familiar course of a physiological treatise. Thereafter he describes the less familiar phenomena known as tropism, and includes figures and descriptions of chemotropism and galvanotropism, which will be new to most readers.

The last chapter, entitled the mechanism of life, contains a large amount of material that, so far as we know, has not yet found its way into text-books. It is inspired more definitely than the other sections of the book by the individual conceptions of the author. He discusses Roux's view of the mosaic nature of living bodies, and details his conception of *biogenes*, the ultimate vital particles or units which, to a certain extent, correspond to the biophores of Weismann, the physiological units of Herbert Spencer, the gemmules of Darwin, the pangenes of De Vries, and the idioblasts of Hertwig. The correspondence, of course, is of the vaguest kind, as these theoretical units are in every case merely a concrete expression of their authors' conception of the nature of vital activities. In this chapter, too, occur Verworn's special views as to the function of the nucleus, views which, as is well-known, differ from those held by most biologists. We have no desire to object to the inclusion of individual views; indeed, after so careful and impersonal a discussion of the main parts of his subject, as is to be found in five-sixths of the volume, the reader is glad to become on more intimate terms with the author.

In so vast an array of subjects, it must necessarily happen that any biologist reviewing the volume should come upon statements he would prefer to modify, conclusions he would wish to combat. But the conception of physiology taken by the author, and the all-embracing treatment he has adopted seem to us so admirable from the point of view of stimulating thought, and so beyond praise in these evil days of narrow specialism, that we have thought it a duty, as we found it a pleasure, to describe rather than to discuss the volume. We believe that Verworn's "General Physiology" is the most notable book we have read for many years, and that it, and the successors it will call into existence, will have a permanent influence on biological teaching. P. C. M.

SOME NEW BOOKS.

Fossil Fishes in the British Museum.

Catalogue of the Fossil Fishes in the British Museum (Natural History). Part III. By Arthur Smith Woodward. Pp. xlii., 554, pls. xviii. London, 1895. Price £1 1s.

The Catalogues published by the Trustees of the British Museum are held in special esteem by students of natural history. As a rule, they are much more than their modest title denotes; for instead of being merely a systematic enumeration of the species and specimens in the British Museum, they are often a comprehensive treatise on all the forms of the particular division of the animal or vegetable kingdom to which they refer. The Catalogue of Fossil Fishes prepared by Arthur Smith Woodward occupies a prominent place among these publications. That which L. Agassiz attempted more than half a century ago and completed with such brilliant results, A. S. Woodward endeavours to repeat in the light of the most modern principles and the present state of knowledge. How enormous, however, has been the increase of palæontological material since that time—how much our knowledge of fossil fishes has grown and deepened—may best be realised by comparing any section of Agassiz's "Recherches sur les Poissons Fossiles" with the Catalogue of the British Museum now before us. Not without a certain amount of sorrow is one convinced by this comparison how fleeting and short-lived are the most important works in the domain of natural history, and in this category may undoubtedly be placed Agassiz's great volumes on fishes. Of the classification of fishes based upon the skin-structures, which L. Agassiz proposed, scarcely anything remains. The orders of Cycloidei and Ctenoidei were long ago shown by J. Müller to be entirely untenable; the Placoidei were limited and defined in a different manner; and that of the Ganoidei alone, the establishment of which Agassiz regarded as the most important result of his long-continued researches, received stronger anatomical support from J. Müller and Carl Vogt, and withstood all the attacks from different sides until quite recently. Its limits have indeed been reduced considerably in course of years; the Placodermi, Dipnoi, and Acanthodi have been excluded and the close relationships of the Ganoidei and Teleostei have been more and more emphasised. Following Kner, Owen, and Cope, A. S. Woodward has also given up this last remnant of the system of Agassiz; his Ganoidei are abandoned, and their former members are divided among the sub-classes of Ostracodermi, Dipnoi, and Teleostomi. Whether the direct opposition of the Crossopterygii to the Actinopterygii will stand the test of time, may indeed be doubted; and likewise the future can only decide whether the complete fusion of the higher ganoids with the bony fishes is to be regarded as a noteworthy step in advance. The fundamental difference between the cartilaginous fishes (Elasmobranchii) and all other fishes becomes more and more recognised; the latter, on the other hand, like the birds, comprise a series of forms so

closely related that hitherto no agreement has been arrived at concerning the definition of the larger sub-divisions. In the first, and in part of the second, volume of his Catalogue, A. S. Woodward has treated the fossil Elasmobranchii; in half of the second volume he has dealt with the completely extinct Ostracodermi, the Dipnoi, the Crossopterygii, and part of the Chondrostei. The classes, sub-classes, orders, families, genera, and species, are well defined; all the fossil forms, including those not represented in the British Museum, are enumerated; the synonymy is critically determined and the literature completely summarised. The third volume contains the remainder of the Chondrostei, all the other ganoid fishes, and part of the Mesozoic bony fishes. In a further volume the later Teleostei are to follow. The most interesting groups from the phylogenetic and morphological points of view are included in the three volumes now published, so that the significance of A. S. Woodward's work can already be completely appreciated. Since the author follows no theoretical course, and contemplates no systematic reform according to his own ideas, but attempts more especially to present the facts in well-arranged and general order according to the latest phase of our knowledge, his Catalogue will be of permanent value in the literature of palæichthyology, and will serve as an inexhaustible source of information, not only for palæontologists and geologists, but also for zoologists and embryologists.

A space of four years intervenes between the appearance of the second and third volumes—a short period of time for the arrangement of the varied and difficult materials which are treated in Part III. For the Chondrostei, it is true there are available the important earlier works of R. H. Traquair; among the Protospondyli, Aetheospondyli, and Isospondyli, Woodward in many cases has had to determine the fundamental method of classification, and to submit to careful critical revision the families, genera, and species represented. Traquair's remarkable researches among the Palæozoic heterocercal scaly ganoids have led to the unexpected result that there exists so great an anatomical resemblance between these fishes covered with typical ganoid scales and the Acipenseroids, that no doubt can exist as to the genetic connection between the two. A. S. Woodward adopts Traquair's views completely, and unites under the heading Chondrostei both the heterocercal-tailed Palæoniscidæ, Platysomidæ, and Catopteridæ, and also the recent sturgeons and paddle-fishes (Polyodontidæ), besides an extinct Mesozoic family (Belonorhynchidæ) with a diphycercal tail. As common characters are enumerated the incomplete ossification of the vertebral column, the smaller number of supports than rays in the dorsal and anal fins, and the more distinct segmentation of the pectoral girdle by the formation of an infra-clavicle and clavicle; or, as Gegenbaur has lately correctly named these bones, a clavicula and a cleithrum. In addition to these principal characters there are still others of less importance, namely, the presence of baseosts in the pelvic fins, the small extension of the preoperculum on the cheek, and the sub-division of the hinder expansion of the maxilla.

With the exception of the Belonorhynchidæ all the Chondrostei have a beautifully heterocercal tail. In the dermal skeleton there is the greatest possible variation. In the Palæoniscidæ, Platysomidæ, and Catopteridæ, the body and tail are completely covered with rhombic, very rarely cycloidal scales; only the aberrant Permian *Dorypterus* appears to have been scaleless. In the Belonorhynchidæ true scales are wanting, but four rows of small bony scutes extend

along the trunk; in the Mesozoic Chondrosteidæ, of which A. S. Woodward figures a finely preserved specimen from the Lower Lias of Lyme Regis, the upper lobe of the tail is covered with fulcra and scales as in the living Polyodontidæ, while the rest of the body is naked. In the Acipenseridæ, besides this covering of the caudal lobe, there are several longitudinal series of large bony plates with smaller star-shaped ossifications between. No one will deny that the Chondrosteidæ, Polyodontidæ, and Acipenseridæ stand in the closest genetic connection, though the future of the Belonorhynchidæ is still very doubtful; but that these cartilaginous ganoids of J. Müller, so remarkably different from the typical ganoids, may probably be derived from the Palæozoic Palæoniscidæ, is one of the most important results of the always exact researches of R. H. Traquair. Nevertheless, whether it is correct to place these primitive scaly forms in the same order as the cartilaginous ganoids, appears doubtful, since even A. S. Woodward points out that between the Triassic Catopteridæ and the older Palæoniscidæ there is as close a connection as between the former and the earliest representatives of the Lepidostei. In any case, it is no breach of existing rules of classification to arrange the primitive ancestral forms in a special group opposed to one comprising their later descendants, which are specialized in various directions.

The Lepidostei or Lepidosteoidei, Pycnodonti, and Amioidei, as hitherto understood, are divided by A. S. Woodward into the three sub-orders of Protospondyli, Aetheospondyli, and Isospondyli. The Protospondyli correspond to the Lepidostei of Huxley, with the exception of the Aspidorhynchidæ and Lepidosteidæ, for which Woodward establishes a special sub-order (Aetheospondyli), which, however, he regards as of only provisional significance, since "the recognition of this group is a confession of ignorance," in consequence of the uncertainty of the origin and relationships of the two families placed here. The name Aetheospondyli is in allusion to the unique variations of the vertebral centra from the bi-concave or amphicœlous to an opisthocœlous type.

The Protospondyli form an unusually numerous derivative series from the primitive Chondrostei, or Heterocerci, as I have termed them. Their vertebral column is never completely ossified but shows different stages in the process of ossification, in part most remarkably suggestive of those observed among fossil Amphibia. In outward aspect and squamation the Protospondyli are most closely connected with their fore-runners, but the caudal fin loses its conspicuous heterocercy, the upper lobe is atrophied, and the caudal becomes hemi-heterocercal or only internally heterocercal; the number of supports in the dorsal and anal fins becomes exactly equal to that of the dermal rays; the clavicle and cleithrum are fused together; the opercular apparatus, *i.e.*, the preoperculum, is reduced, and the baseosts of the pelvis disappear. Most of the families of Protospondyli are closely connected, so that their definition is difficult; they were probably already differentiated at the beginning of the Mesozoic period.

The section on the Protospondyli abounds in new and important observations; it forms the main part of the third volume. The subdivision of this great order from which the typical Teleostei have arisen, into the families of Semionotidæ, Macrosemiidæ, Pycnodontidæ, Eugnathidæ, Amiidæ, and Pachycormidæ, is much better than all previous attempts at classification. The Semionotidæ correspond to the Stylodontes and Sphærodontes of A. Wagner, and comprise fishes with thick shining rhombic ganoid scales, which are closely related to the Catopteridæ in their anatomical characters and

their geological distribution. They arise in the Upper Permian and attain their maximum development in the Trias, Lias, Jurassic, and Lower Cretaceous. The osteology of most of the genera is treated with great completeness, and the skull and skeleton of *Lepidotus* are specially described in a remarkable way. A restoration of the complete fish and several drawings of the head, leave very little more to be learned concerning this grand and widely-distributed fish. The genus *Dapedius* is treated in a similar manner, new and important facts being added concerning the skeleton of the trunk. The comparatively small family of Macrosemiidæ includes only seven genera with slender trunk, enamelled scales, and pointed teeth, especially distributed through the Jurassic rocks (*Ophiopsis*, *Histionotus*, *Legnonotus*, *Macrosemius*, *Petalopteryx*, *Propterus*, and *Notagogus*). The systematic position of the interesting Pycnodontidæ, ranging from the Jurassic to the Eocene, has hitherto been misunderstood by almost all authors. From their singularly deep and laterally compressed trunk, their peculiar scales, and their dentition, these notochordal fishes have mostly been regarded as a separate order equivalent to that of the Lepidostei. On account of a superficial resemblance they have often been considered as descendants of the Platysomidæ. The careful researches of Woodward leave no longer any doubt that the Pycnodontidæ belong to the typical Protospondyli, and that they bear almost the same relation to the Semionotidæ and Macrosemiidæ as the Platysomidæ to the Palæoniscidæ. The two families form analogously differentiated branches of the Heterocerci and Protospondyli respectively, which were apparently not capable of further development and left no descendants. Traquair had already emphatically denied all genetic connection between the Platysomidæ and the Pycnodontidæ. A. S. Woodward determines the systematic position of the latter with absolute certainty, and the view of Egerton, which I had likewise adopted, is finally abandoned. The twelve genera of Pycnodontidæ, like those of the other families, are very carefully revised, a number of superfluous genera and species are relegated to the synonymy, and the whole of the widely scattered material is arranged in a masterly manner. Several genera are illustrated by finely executed figures.

Under the denomination Eugnathidæ, Woodward includes a number of Mesozoic fishes with imperfectly ossified vertebral column, a deeply cleft mouth, pointed teeth, and slender trunk, which begin in the Trias and become extinct in the Chalk. The ganoid scales are rhombic, sometimes rounded at the hinder angles, and of very variable thickness. The genera belonging here (*Eugnathus*, *Heterolepidotus*, *Allolepidotus*, *Ptycholepis*, *Caturus*, *Callopterus*, *Eurycormus*, *Neorhombolepis*, *Lophiostomus*) have hitherto been separated in different families, and their osteology has been insufficiently known. Some of the species until now referred to *Pholidophorus*, are transferred to *Eugnathus* or *Heterolepidotus*, and the great similarity between the skull of *Caturus* and that of *Eugnathus* is pointed out in a convincing manner. Woodward assigns small importance to the characters of the scales; among the Eugnathidæ we therefore find genera with thick polished rhombic ganoid scales and others with thin, cycloidal, deeply imbricating, enamelled scales. As among the Semionotidæ and Macrosemiidæ, the latest genera are characterised by the most advanced ossification of the vertebral column, which, as in *Amia*, results in the formation of complete centra.

Between the Eugnathidæ and Amiidæ the distinction is slight; the vertebral column in the latter is generally better ossified, and the dermal skeleton always consists of thin cycloidal scales. The two

older genera, *Liodesmus* and *Megalurus*, begin in the Jurassic; the third, *Amia*, begins in the Lower Chalk and survives to the present day.

A. S. Woodward regards the Pachycormidæ, which appear first in the Upper Lias, as a remarkable modification of the thin-scaled Eugnathidæ. The vertebral column of these fishes, which are mostly large, is divided into very numerous short segments, but incompletely ossified, being formed either of half-vertebræ or ring-vertebræ. It turns upwards at the hinder end, without, however, being continued into the upper lobe of the powerful, deeply-cleft tail-fin; an unusually expanded hæmal arch at the basis of the lower lobe shows, notwithstanding the complete outward homocercy, the typical structure of the Protospondylic tail. The strong pectoral fins indicate a remarkable power of swimming. In the older genera (*Sauropsis* and *Euthynotus*) the jaws above and below are provided with stout conical teeth and are rounded off in front; *Hypsocormus* and *Pachycormus* are characterised by the strong development of the dentition, and in one species of *Hypsocormus* from the Oxford Clay of Peterborough the premaxilla is elongated into a prominent rostrum with powerful teeth, as in the Cretaceous genus *Protosphyræna*, where it becomes a long conical process. The union of this hitherto incompletely known genus with the Pachycormidæ is somewhat surprising and still needs further proof.

In the extensive order of Isospondyli Cope places a large number of true bony fishes from the Cretaceous, the Tertiary, and the present day. Woodward partly follows the celebrated American palæontologist, and deals in the volume before us with the three oldest families, the members of which Agassiz assigned to the Ganoidei. Until now indeed, the Pholidophoridæ have been generally recognised as ganoids. Like the majority of the Protospondyli their body is covered with rhombic ganoid scales articulated together; the vertebral column consists chiefly of ring-vertebræ; on the other hand, the want of a splenial and a coronoid element in the lower jaw points to their inclusion in the Isospondyli. The few genera are distributed through the Trias and Jurassic. The closely-related Oligopleuridæ range from the Jurassic to the Upper Chalk. In many respects they are suggestive of the Amiidæ; their scales are thin and cycloid, their vertebral column is completely ossified, but not with separate pleurocentra and hypocentra like those of *Amia* in the caudal region. The Leptolepidæ have already been separated from the group of ganoids by Kner, Thiollière, Lütken, and most authors, and assigned to the Teleostei. They are very sharply separated from the Pholidophoridæ and Oligopleuridæ by the want of fulcra on the fins and by a considerable development of inter-muscular bones. The vertebral column is also completely ossified, consisting of amphicœlous vertebræ, and the tail is both internally and externally homocercal. The Leptolepidæ are remarkably similar to the Clupeidæ, but are distinguished from the latter by the parietal bones meeting in the middle line, by the simple, separate hæmal spines at the base of the tail, and by the stronger development of the enamel on the scales. The genera *Leptolepis*, *Aethalion*, and *Thrissops*, indeed, form the passage between the ganoids and the teleosteans.

The sharp definition of the principal groups (sub-classes and orders) within the great classes of the animal kingdom presents great difficulties, not only among the fishes, but also among the Invertebrata; we are, indeed, well aware that in reference to the rational subdivision of the Anthozoa, Crinoidea, Cystoidea, Brachiopoda, Lamellibranchiata, Gastropoda, Cephalopoda, etc., there are as wide differences of opinion among authors as in reference to the prime

divisions of the fishes. The Palæichthyes of Günther may now be definitely buried, since A. S. Woodward has provided for us a complete summary of the Palæozoic and Mesozoic fishes, and no one who has followed the progress of ichthyological studies can conceal from himself the fact that the further recognition of the existence of the ganoids is seriously endangered now that the three best authorities on fossil fishes, Cope, Traquair, and A. S. Woodward, have pronounced against it. The families established by Woodward in the third volume are all defined and characterised with such care that they can, indeed, for the most part, be little affected by the varying views on classification. They include closely-related forms and represent natural stages in the course of development in this large class of vertebrates. Woodward's catalogue deserves the highest praise, not only for its completeness, but also for its critical acumen and the incomparable mode of handling of the material with which the author deals. When completed, this work will form the basis for all palæichthyological researches for the next decades. The beautiful restorations of eight Mesozoic genera in the text ought soon to banish from text-books the familiar figures of Agassiz. Like the eighteen lithographic plates, they are the work of the skilful and trained pencil of Miss Gertrude Woodward, and undoubtedly rank among the best pictorial representations of fossil fishes. KARL VON ZITTEL.

THE BRAIN AND "BRAINS."

THE GROWTH OF THE BRAIN; A Study of the Nervous System in Relation to Education. By Henry H. Donaldson, Professor of Neurology in the University of Chicago. Contemporary Science Series. Pp. 369. London: Walter Scott, Ltd., 1895. Price 3s. 6d.

THIS excellent little book covers a field even wider than its title implies. Considerable advances have been made in recent years in our knowledge of the comparative anatomy, the minute structure and development, and the physiology, both human and comparative, of the central nervous system. Psychology has been pursued from the experimental rather than the metaphysical side, and education has become a science as well as an art. Professor Donaldson has collected a large body of facts and statistics from all these departments of knowledge, and has so marshalled them as to illustrate very fully the development of the central nervous system and the physiology of education.

The freshness of the book lies, not so much in new and original matter, of which there is little, but in the treatment and grouping of facts already established, and in the logical deductions drawn from them. The introductory chapters deal with the facts of growth in general, and are illustrated by numerous tables and curves. The absolute weights of the central nervous system and its chief component parts are then discussed from various points of view, after which its curves of growth are given, showing that by the seventh year, practically before formal education has begun, the brain has already reached nearly to its adult weight. The influence of brain-weight as a factor in determining intelligence receives critical discussion. The minute structure and development of the nervous system is next considered, and particular attention is devoted to the relative volumes of the nerve-cells and their processes in comparison with the embryonic germinal cells from which they arise. From the best statistics available (Meynert, His, and others) it is deduced that there is no need for the production of new nerve-elements after the

third month of fœtal life, subsequent increase in size depending upon the enlargement of already formed cells. It would thus appear that environment and training have little or no influence in producing new cells, but produce their result by perfecting the development and inter-relationship of pre-existing materials. These considerations are employed with some success in explaining the phenomena of the growth of the brain, and the differences in the brain-weights of the sexes and the different races of mankind. The architecture of the nervous system, the arrangement of its structural elements into systems, and the development of the latter, form the subject of several chapters, which conclude the anatomical and larger section of the book.

The later chapters deal with function and its development, treating them, not from the point of view of the text-book of physiology, but rather from the psychological side. This part of the book is fully as well written and suggestive as the preceding, and leads up, after a chapter on "fatigue" and one on "old age," to the consideration of the education of the nervous system. It may be regretted that more space is not devoted to this last subject, since it is the one to which the whole book has led up, and further, that it is dealt with in so general a manner. The value of the book to the educationalist would have been considerably enhanced by a chapter on the practical outcome of the considerations which have been enforced. Nevertheless, the work will be of much interest to those teachers who have sufficient knowledge to master its technical details, while the psychologist and physician will find it a well-written and valuable *resumé* of neurological science.

MILK FOR GERMAN BABES.

GRUNDRISS DER KRYSTALLOGRAPHIE. By G. Linck. 8vo, pp. vi., 253, with two coloured plates and numerous figures. Jena: G. Fischer, 1896. Price 9 marks.

THIS is a text-book intended for young students and beginners, but we doubt whether it will be a favourite book with those for whom it is intended, unless the German student is a hardier person than we imagine. Too much information is squeezed into too small a space; an attempt is even made to give an intelligible account of the large subject of Chemical Crystallography in the last eleven pages, after the geometry and physics of the subject have been packed into the first 230 pages. On the very first page, where it is merely stated that tourmaline becomes electrified by friction, Professor Linck thinks it necessary to insert after the word "Turmalin"

$$(n\ Si_{12}\ O_{69}\ B_6\ Al_{16}\ R_4\ H_8 + n\ Si_{12}\ O_{63}\ B_6\ Al_{10}\ Mg_{12}\ H_6).$$

This we quote in order to illustrate, not so much the process of squeezing into too small a space, as the superfluity of information.

In some matters the author is fully up to date, *e.g.*, in the reference of the optical characters of crystals to the geometry of the Indicatrix; in others he is lamentably behind the times, as in the retention of the Naumannian system of notation. It is true that the Millerian symbols are also given, but we had hoped that, since the publication of the classic works of Mallard, Liebisch and Groth, no text-book would introduce the more cumbersome notation except as a thing of historical interest. The diagrammatic representation of the various types of symmetry by means of shaded areas does not appeal to the eye like perspective figures, or like stereographic projections. That the projection on a sphere should not be even mentioned is an omission which is almost unpardonable in a modern text-book of crystallography.

The author introduces a new law under the name of Eutropy, with the following signification:—In a series of analogous compounds, each of which contains a different element taken from the same horizontal line (in Mendeleef's series), while they are all alike in other respects, their crystals constitute a similar series in which all the crystallographic properties alter in a regular manner with the increase or decrease of the atomic weight of the characteristic element. This statement has been recently elaborated by Professor Linck and one of his pupils in *Ostwald's Zeitschrift*, but seems scarcely yet established on a sufficiently wide basis to be given as a general law in an elementary text-book. It is simply an extension of the accurate work recently done on the sulphates by Mr. A. E. Tutton.

We have pointed out various shortcomings of this book in the interests of the readers for whom it is intended, but must in justice add that in the matter of information it is remarkably complete and well suited for more advanced students. The classification of twin-crystals on p. 24 seems both logical and lucid. A word of praise is due to the figures, and especially the coloured plates, which are excellent; but when all is said the question remains—Why are not elementary text-books on Crystallography more readable?

Man and his Ancestors.

The Structure of Man: an Index to his Past History. By Dr. R. Wiedersheim; translated by H. & M. Bernard, with a preface by Professor Howes. Pp. xxi., 227, with 105 figs. London: Macmillan & Co., 1895. Price 8s.

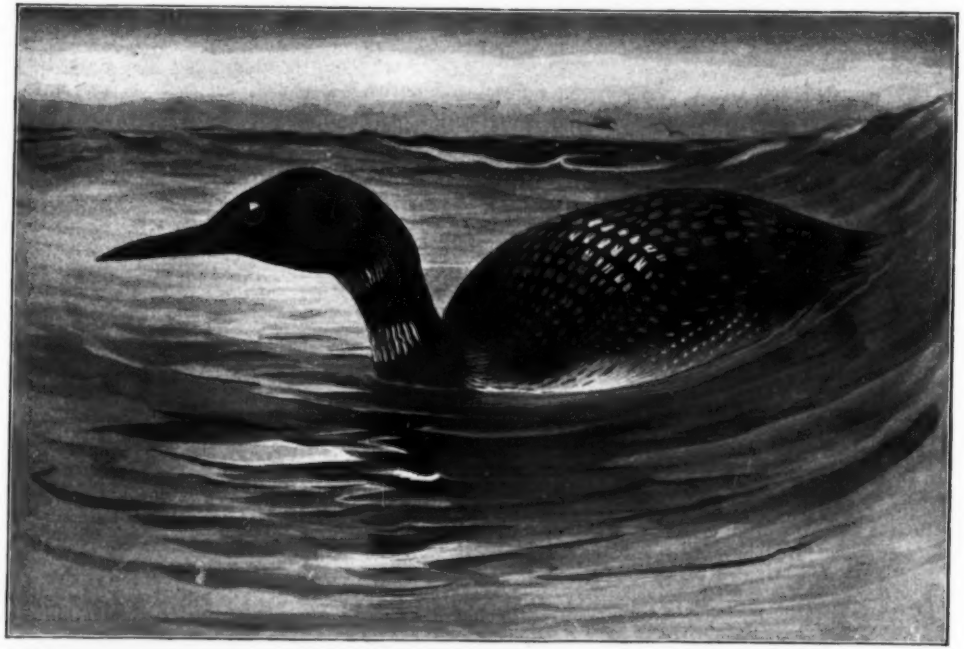
Professor Howes has, we think, been well advised in securing the competent assistance of Mr. and Mrs. Bernard in placing this highly interesting work in the way of those anatomists who are unable to read German. He has done a further service to those readers in adding a few notes on his own account; these notes are placed in square brackets, and are deftly woven into the text, so deftly that no one, were it not for the brackets, would have the remotest idea where Professor Wiedersheim left off and Professor Howes began. The book is practically a *resumé* of vestigial structures in man, and of certain rare reversions to what has been thought to be an ancestral condition. Thus, hairy men and women, supernumerary mammæ, and such like monstrosities occur in abundance, while the inferiority of the negroes, and particularly of the Veddas, is duly emphasised by the damning frequency of the occurrence of ape-like characteristics. Sometimes perhaps both the author and his editor become unnecessarily discursive. We have wearied for a considerable period of the pineal eye; and why, seeing that "the pineal gland of Anthropoids is identical in appearance with that of man," should we have three or four pages, illustrated, upon its general characters in reptiles and fishes? The glossary, too, appears to us to be a work of supererogation as an appendix to a book written for persons who presumably have some acquaintance with the general facts of anatomy. But as both the author and his editor are professors, they may have a lower and possibly more correct opinion of the knowledge possessed by those whom they address. Still, every student of anatomy must surely have heard of histology, of anatomy, and even of biology; definitions in five words would seem unnecessary—though, to be sure, we have heard of a candidate for a lectureship at a medical school who was perfectly aware of what was meant by Zoology and Botany, but could not understand what the advertisement meant by requiring a lecturer upon Biology.

BRITISH BIRDS FOR THE BRITISH PUBLIC.

BRITISH SEA BIRDS. By Charles Dixon, with eight illustrations by Charles Whymper. 8vo. Pp. ix., 295. London: Bliss, Sands, and Foster, 1896. Price 10s. 6d.

THERE is a fascination for most minds in the study of the graceful and varied evolutions of the birds which haunt our coasts and estuary-rivers. Not only do we find a pleasure in studying their migratory movements. The annual return of the nesting-time suggests the possibilities of fresh visits to islands and surf-beaten skerries, upon which the beautifully mottled eggs of the sea-fowl are to be viewed amid their own characteristic environment. Mr. Dixon is the author of several volumes of popular essays on bird-life. The latest addition to their number is well written, and should be of service to those who are but slightly aquainted with the subject. The facts here woven together have no striking or unfamiliar features. We do meet with one or two startling statements, it is true, such as that the smew is to be seen, presumably in British waters, in flocks, consisting "of thirty or forty individuals." If Mr. Dixon had told us that this observation related to the river-reaches of Northern China, we could have accepted his statement without difficulty. As a matter of fact, we have never met with any large flocks of smews in Britain, though we have spent hours in watching the manœuvres of single individuals. *Small* flocks do appear in winter on certain Norfolk waters; but to speak of parties of "thirty or forty" birds visiting the British Isles, appears to be decidedly inaccurate. Many of Mr. Dixon's observations refer to the coast of Devonshire; if he had consulted the notes of the best of modern Devonian ornithologists, he would not have circulated the statement that the great northern diver feeds almost exclusively on fishes. As a matter of fact, it subsists largely on Crustacea. But these and similar blemishes do not detract seriously from the value of a book, which can, in any case, convey nothing new to the well-read ornithologist.

On the other hand, that large section of the public which is guiltless of any aquaintance with avian matters will find some pleasant and easy reading in Mr. Dixon's compilation. He is not without some personal knowledge of his subject, and has the knack of making the most of any observations recorded in his field-journals. Moreover, he writes in concise language, and scouts the long-winded sentences in which more learned naturalists are apt to clothe their thoughts. We object to the coining of new and unauthorised phrases. Mr. Dixon's adjective *avine* is not less objectionable to our judgment than Mr. Harvie Brown's new synonym of *vagratory* for migratory. But this has nothing to do with the scope of the pretty volume on our table. Perhaps its most useful feature lies in its treating of almost every species of bird that is to be met with near our seas. Mr. Dixon descants in brief but readable terms on the habits of all manner of ducks and wild-fowl. Not only so, but he introduces us to the haunts of the chough, the rock pipit, and other land birds. The usefulness of the volume would have been increased if Mr. Dixon had taken the trouble to tell the uninitiated how to distinguish between the different plumages of the ruff, or by what means to recognise the white-billed diver in its winter dress. Many similar points will occur to the professed ornithologist. But the author avowedly treats of a picturesque subject in a superficial manner, and it would be unfair to treat this volume as aspiring to claim a place among scientific works. It worthily fills the rôle of a popular educator in the most obvious details regarding the birds of



THE GREAT NORTHERN DIVER.

(From Dixon's Sea Birds. Drawn by Charles Whymper.)

[To face p. 416.

AMERICAN MUSEUM
OF NATURAL HISTORY
CENTRAL PARK
NEW YORK

which it treats, and is more free from mistakes than many popular works on natural history. The full-page plates of British Birds, one of which the courtesy of the publishers enables us to include (Plate VII.), are well executed, and will enhance the merit of the work in the eyes of holiday-makers, for whose consumption upon the beach this effort seems to have been chiefly intended.

Fossilised Botany.

Catalogue of the Mesozoic Plants in the Department of Geology, British Museum (Natural History). The Wealden Flora. Part II. Gymnospermæ. By A. C. Seward, M.A., F.G.S. 8vo. Pp. viii., 259, 9 woodcuts and 20 plates. London, 1895. Price 15s.

In the first part of the Catalogue Mr. Seward described the Algæ, Characeæ, Equisetineæ, and Filicineæ of the Wealden, and, as no Angiospermæ have been discovered, part ii., including the Cycadeæ and Coniferæ, concludes the work.

In reviewing the book it is important to understand clearly what should be our point of view. Certainly not that of systematic botany. The catalogue is an admirable illustration of the present position of palæobotany, and its unhappy separation from the study of recent plants. Its author has, we doubt not, often regretted the many stairs which have to be traversed in passing to and fro between the great herbarium and the Geological Gallery at Cromwell Road. And, lest we should seem to depreciate its value, let us say at once that careful, thorough, and critical enumerations like the present will go a long way towards uniting the two branches of study, by demonstrating the unsatisfactory character of the present method, and, secondly, by affording material for a more comprehensive survey.

The author is not to blame for the faulty method, and his work must be criticised as an account of the gymnosperms of the Wealden flora. As such it is eminently useful. Every specimen is described in detail, while the numerous excellent plates are an additional help. Each family and genus is introduced by a valuable account of its occurrence and the literature relating thereto, with numerous critical remarks and often useful hints and warnings gleaned from a study of allied present-day forms. It is, however, hard to reconcile some of the author's scientific remarks *àpropos* of the great variations known to occur in some genera of Coniferæ, and the consequent danger of describing new species on unsatisfactory material, with his foundation of a new genus *Becklesia* (p. 179) on specimens which are "too imperfect to admit of any satisfactory generic or specific diagnosis." The more so as there are already two names in existence for specimens which "present a more or less close resemblance to *Becklesia anomala*." And why honour with a new binomial (*Pinites Ruffordi* sp. nov.) "a specimen of coniferous wood with the minute structure clearly preserved, and showing the characters of the genus *Pinites*"? Why not "Wood of *Pinites* sp."? There are several species of the genus in the same beds, and it seems probable that the wood belonged to one of them. What is gained by giving it a new specific name which is nothing more than a specimen label? The practice is, moreover, misleading, for it implies that there are a larger number of species of the genus in question in the given horizon than we have any evidence of.

As Mr. Carruthers has already pointed out in the *Journal of Botany* (May), Mr. Seward's neglect of principles generally recognised in botanical nomenclature is matter for regret. The specimens

include leaves, scales, seeds, flowers, and stems, and are described in the order indicated. From the list at the end of the volume the Wealden flora is seen to contain about forty "species" and varieties, more than half of which are gymnosperms, while two are alga-like organisms, and one each is assigned to Charophyta and Bryophyta. Finally, the author says, "Looking at the Wealden plants collectively, we notice a very striking agreement with the flora of the underlying Jurassic strata, and it would be difficult to point to any well-marked or essential difference between the plant-life of the two periods. The evidence of palæobotany certainly favours the inclusion of the Wealden rocks in the Jurassic series." He adds a few words of regret that no light is thrown on the evolution of angiosperms, and suggests that the Wealden vegetation would seem to have been without any examples of the highest class of plants, and may be looked upon as the last of the Mesozoic floras in which the gymnosperms represented the limit of plant development. The inflorescence of *Bennettites* is the only indication of "a distinct advance in the differentiation of reproductive structures beyond the characteristic cycadean type."

The "list of works quoted" forms a useful bibliography; and a comprehensive and, so far as we have tested, accurate index concludes the text.

Education in Botany.

ELEMENTS OF BOTANY. By J. Y. Bergen, A.M. 8vo. Pp. 275 and 57. Boston, U.S.A., and London: Ginn & Co. 1896.

THIS little book, which has grown out of a teacher's notes, is one of the right sort. The boys and girls for whom it is intended are made to acquire their knowledge by experiment and observation. They sow seeds, watch them growing, and study the conditions of growth. They examine buds and record what they see. They are told something of the wonderful relations which subsist between flowers and insects, and then encouraged to investigate some of the adaptations by which the plant benefits from a welcome visit or protects itself against an unwelcome one. Their powers of thought and observation are stimulated by suggestive questions—What is the use of this? or the reason of that? Why is the pulp of so many fruits eatable? Why are the seeds of many pulpy fruits bitter or otherwise unpleasantly flavoured? Why are the seeds or the layers surrounding the seed too hard to be chewed? A course like the one followed in this book will ensure not only a fair knowledge of the elements of botany, but what is of more importance, the best kind of education. So much for part i., comprising with its four appendices and index 275 pages. Part ii. is merely a small flora, including the commoner spring flowers of the middle and northern States, and adds little, if anything, to the general usefulness of the book.

New Serials.

To the many new serials hailing from Russia and recently noticed by us must be added *Annuaire Géologique et Minéralogique de la Russie* (Ezheghodnīk po Gheologhiī ī Mīneraloghiī Rossiī), edited by N. Krichtafovitch, and printed at Warsaw, but published at Novo-Alexandria, gouvernement de Lublin, Institut agronomique et forestier (price 10s. per annum). Vol. i., livr. 1, for 1896, is before us; it is a 4to, printed in Russian and French (or German) in parallel columns. The contents are arranged in six sections, each with independent pagination, as follows: Memoirs and original Notes,

23 pp.; Bibliography of Russian Geology for 1895, 96 pp.; News of Expeditions, 13 pp.; Personalia and Obituaries, 16 pp.; News of Russian Museums, no pages in this livraison; Advertisements of Sale or Exchange, 2 pp. To some extent this ground is covered by Professor Nikitin's useful *Bibliothèque géologique russe*, to which the present work appears to be a rival, a fact to be regretted. It is claimed that the abstracts will be much fuller than those in the *Bibliothèque*; but papers that have already been noticed in some accessible publication, such as the *Neues Jahrbuch*, are not again abstracted. In the palæontological lists, the names of new species are printed in broad-faced type, which seems to us a great improvement on the method followed by the *Zoological Record*.

Revista de la Facultad de Agronomía y Veterinaria (8vo, La Plata, annual subscription, 6 pesos m/n) was started as a monthly at the beginning of 1895. No. 7, which we have just received, contains a report submitted by Drs. Bernier and Griffin to the High Council of Hygiene for the province of Buenos Ayres, in which they recommend certain regulations for checking the spread of contagious diseases among domestic animals. The laws on the subject are more stringent in other countries than in Buenos Ayres, and protection can only be secured by the enforcement of sanitary laws. The report embraces rules for the declaration of contagious disease and the penalties for non-compliance, the manner and duration of the isolation of suspected cases, the sacrifice and burial of infected animals, and a scale of compensation for animals so destroyed. The article, although occupying only a few pages, should not be missed by sanitarians. The number also contains a paper on the disinfection of cattle-trucks, by Dr. Bernier, and other interesting matter.

The Illinois Wesleyan University at Bloomington, Ill., has started a magazine devoted to the interests of graduate and non-resident students, entitled *The Illinois Wesleyan Magazine*. We mention it here since it seems possible that occasional articles of interest to our readers may be found in it. Part ii. contains a short note on the home study of geology, by R. O. Graham, and a doctorial thesis on the problem of latitude, by O. J. Bond.

We record, though they contain little of scientific interest: *Boletin del Museo-Biblioteca de Filipinas*, 4to, about one sheet to each part, published at Gunao 12 (Quiapo) Manila; and *Travel*, a monthly, of which the first number was issued on May 1, 1896, by Horace Marshall & Son, 125 Fleet Street, London. It is an 8vo, of 58 pages, sold for 3d.

Literature Received.

The Student's Lyell, J. W. Judd: Murray. Germinal Selection, A. Weismann: Open Court, Chicago. History of Mankind, pt. viii., F. Rätzel: Macmillan.

Catalogue xxxiii.: Friedländer. Bees of the Genus Perdita, T. D. A. Cockerell: *Proc. Acad. Nat. Sci. Philadelphia*. The Polynesians and their Plant-Names, H. B. Guppy: *Vict. Inst.* XIXth Report on Noxious and Beneficial Insects, S. A. Forbes. The Mediterranean Flour-Moth, W. G. Johnson: State Entom. Office, Illinois. Blissus Leucopterus, F. M. Webster: *Journ. Cinn. Soc. Nat. Hist.* The American Lobster, F. H. Herrick: U.S. Fish Commission. Les Musées de l'Avenir, A. L. Herrera: *Mem. Soc. Sci. "Alzate," Mexico*. Catalogue, xv.: Geographical Botany: Dulau. Horse's Foot, Frog Structure, A. E. Mettam: *Veterinarian*. Garnets, T. H. Holland: *Rec. Geol. Surv. India*. Crambidæ of N.A., C. H. Fernald. Address, H. Woodward: Geol. Soc. London. Fish Culture, J. J. Armistead: Royal Inst. Cave-Drawings in Palmer Goldfields, R. L. Jack: *Proc. Roy. Soc. Queensland*. Report for 1895: Albany Mus., South Australia. Apheliniæ of N.A., Grass and Grain Flies, L. O. Howard. The San José Scale, L. O. Howard and C. L. Marlett; The Honey Bee, F. Benton. Proc. Ann. Meeting Assoc. Econ. Entomologists: U.S. Dept. Agric.

Memorias, Soc. Ant. Alzate, Mexico, t. ix., nos. 1, 2, 3, 4, 5, & 6; Minn. Botan. Studies, Bull. ix., pt. viii.; Notarisia, April; Nature, April 30, May 7, 14; Knowledge, May; Revue Scientifique, April 18, 25, May 2, 9; Irish Naturalist, May; Feuille des jeunes Naturalistes, May; Amer. Journ. Science, May; Naturæ Novitates, April; Amer. Nat., April, May; Science, April 10. 17. 24. May 1; Scott. Geogr. Mag., May; Science Gossip, Feb.; Naturalist, May; Westminster Review, May; Amer. Geologist, May; Botan. Gazette, April; Review of Reviews, May; Biology Notes, April; Photogram, May; Psychological Review, May; Oxford Univ. Sci. Club Journal, 38.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Mr. Frederic Du Cane Godman has been elected a Trustee of the British Museum.

We note the following appointments:—Dr. A. A. Kanthack, of St. John's College, to be Deputy Professor of Pathology at Cambridge, while Professor Roy is unable to lecture; Mr. Robert Harrison, to be Assistant Secretary to the Royal Society, in place of Mr. H. Rix, resigned; James G. Lawn, Instructor in Mine Surveying at the Royal College of Science, London, to be Professor of Mining at the South African School of Mines; Dr. L. Joubin, to be Professor of Zoology to the Faculté des Sciences, Rennes; Dr. H. Prouho, to be Professor Adjunct of Zoology to the Faculté des Sciences, Lille; Dr. A. Fleischmann, to be Extraordinary Professor of Anatomy and Zoology, and Director of the Zoological Institute at Erlangen; Dr. Ludwig Kathariner, of Würzburg, to be Professor of Zoology and Comparative Anatomy at Fribourg University; Dr. Hermann Henking, to be Extraordinary Professor of Zoology at Göttingen University; Dr. G. Rörig, Teacher in Entomology at the Agricultural High School at Berlin, to be Extraordinary Professor of Zoology in Königsberg University; Dr. Zuber, of Lemberg University, to be Extraordinary Professor of Geology; Professor F. S. Monticelli, of Sassari University, to be Professor of Zoology at Cagliari University; Procopianu-Procopovici, to be Inspector, Dr. Theodorescu and Madame Malinescu, to be Assistants, at the Botanic Gardens, Bucharest; Dr. Victor Schiffner, to be Extraordinary Professor of Systematic Botany in the German University at Prague; Drs. H. Harms, Th. Loesener, and P. Graebner, to be Assistants in the Imperial Botanic Museum at Berlin; Drs. R. Wagner and A. I. Grevillius, to similar appointments in the Botanic Institutes of Munich and Münster, respectively; Dr. Fr. Siche, to be Professor of Pomology in the Pomological Institution at Kloster-Neuberg; L. S. Cheney, Instructor in Botany at Wisconsin University, to be Assistant Professor of Botany in the College of Pharmacy; Dr. R. H. True, Instructor, to be Assistant Professor of Pharmacognoscy in Wisconsin University; Dr. Henry Skinner, to be Professor in the Department of Insecta in the Philadelphia Academy of Natural Sciences; Dr. H. F. Reid, of Cleveland, Ohio, to be Associate Professor of Geological Physics in Johns Hopkins University; Professor E. B. Delabarre, of Brown University, to be Director of the Psychological Laboratory of Harvard University, during the absence of Professor Münsterberg next year; J. E. Lough, to be Instructor in Experimental Psychology, and C. M. Bakewell, to be Instructor in Psychology at Harvard; Dr. H. Newland to be Fellow of Columbia University in Geology, P. A. Rydberg in Botany, H. E. Crampton, jun., and J. H. Macgregor in Zoology, and S. J. Franz and L. B. McWhood in Psychology.

The following changes have recently been made on the staff of the Geological Survey:—A. Strahan, to be Geologist on the English branch, in place of J. R. Dakyns, who has retired after 34 years' service; C. T. Clough, to be Geologist on the Scottish branch, in place of the late Hugh Miller. These gentlemen are succeeded as Assistant Geologists by Mr. T. Crosbee Cantrill, B.Sc., and Mr. E. H. Cunningham-Craig, in England and Scotland respectively.

Dr. Molengraaf, of Amsterdam, whose work in South African geology is well known, has been appointed State Geologist by the Transvaal Government. It is more likely than not that the Geological Survey will be persevered in longer in the Transvaal than it was in the Orange Free State, as the inducement of having gold

finds always in view is strong in the Transvaal and did not exist in the Orange Free State.

THE great age of Dr. James Hall, of Albany, does not prevent the Committee of the New York Legislature from recommending that the State Geological Survey be placed entirely under his direction.

THE Royal Belgian Academy of Sciences has elected Professors E. Strasburger, E. D. Cope, E. J. Marey, and Sir A. Geikie as honorary members, and Professor J. J. Fraipont as corresponding member.

THE Zoological Society of New York has elected as its first honorary members Sir William Flower, Professor Alexander Agassiz, and Professor J. A. Allen.

MR. W. JAMES HORNADAY, to whose work we alluded in our supplement on Taxidermy as a Fine Art, August, 1894, has been appointed director of the proposed Zoological Park at New York, whither he will carry the experience gained in connection with the establishment of the National Zoological Park at Washington. The question he will be called upon to decide is: Where is the park to be placed?

THE vacation class under the direction of Mr. Garstang, at the Plymouth Marine Biological Laboratory, to which we called attention on p. 148, proved a great success. Fifteen students from Cambridge, Oxford, Owens College, and University College, London, attended. It is proposed to hold a similar class next August. We regret to hear that no students availed themselves of Mr. Church's proffered instruction in Marine Botany; it is a subject that does not pay in examinations.

THE first session of the Bahama Biological Station under the direction of Professor Charles L. Edwards, of Cincinnati, was held during the summer of 1893, at Bimini Islands, Bahamas. "For the coming season," says *Science*, "it has been decided to locate the laboratory at Biscayne Bay, Florida," which is in the same latitude as the Bimini Islands, and has the same climate, clear water, and subtropical fauna and flora. The course, which consists of lectures, practical work in the laboratory, and observation of the organisms in their natural surroundings, will begin on June 22. A collecting department has also been established to supply outside students and institutions with material.

THE Museum of Practical Geology, Jermyn Street, was opened on a Sunday for the first time on May 10. The number of visitors was 511, which is by no means unsatisfactory considering the technical nature of the museum. The British Museum, and its branch, the Natural History Museum, were first opened on a Sunday on May 17, from 2.30 to 7 p.m. The hours of opening will vary at different times of the year. The British Museum was visited by 1,790, and the Natural History Museum by 2,398. At the latter building guides were sold, and to counteract their natural dryness the refreshment bar was permitted to be open. The hours of opening of the South Kensington and Bethnal Green Museums have been extended to 7 p.m. We may complete our list by mentioning that the National Gallery was opened on Sunday, May 3, from 3 to 6 p.m., and will continue so to be open on Sunday until September 15. We notice that Dr. Farquharson has been enquiring in the House of Commons whether it is the case that some of the officers at the National Gallery are employed more than six days in the week in consequence of Sunday opening. How this can be, when the omniscient Mr. Stead tells us in the *Review of Reviews* that "no officer shall be employed more than six days a week," we fail to understand. Such action was certainly not contemplated by those who passed the resolution in favour of Sunday opening, and we can hardly suppose that there is any foundation for those rumours concerning the National Gallery and other national institutions. The *Westminster Review* for May contains an article by Stoddard Dewey, entitled "The Triumph of Sunday Opening," as well as

remarks on the present situation of Sunday opening from the Bishop of Winchester, Canon S. A. Barnett, Lord Hobhouse, G. J. Holyoake, and Mark H. Judge.

THE Museum of the Canadian Geological Survey at Ottawa contains a number of valuable specimens, by no means confined to rocks and fossils. During 1895 it was visited by nearly 27,000 people, and has therefore some popularity. The building, however, is too small for the proper exhibition, and even preservation, of the collections. Dr. G. M. Dawson, in his *Summary Report* recently issued, urges that provision should be made by the Government for the proper accommodation of the specimens.

IN connection with the office of the Iowa Geological Survey at Des Moines, a museum has been established, chiefly devoted to the economic geology of the State. Samples of building-stones, brick-earths, clays, and minerals from the lead and zinc regions have been gathered together. A large number of photographs of geological interest have been made, and copies of these are offered at cheap rates to the various schools and colleges of the State.

AN appropriation of $500,000 has been made by the Government of New York for building a third wing to the American Museum of Natural History.

THE American correspondent of *Nature* states that Castle Garden, in New York City, has been converted into an aquarium, pure sea-water being filtered from the adjoining harbour through the underlying strata.

THE Oxford University Junior Scientific Club held a successful conversazione in the University Museum on Tuesday, May 26. The fifth Robert Boyle lecture will be delivered on Tuesday, June 2, by Prof. W. Ramsay, on Argon and Helium.

A COMPLAINT was made last year that geology was unrepresented among the new Fellows of the Royal Society. This year, however, we note in the list of selected candidates the names of Dr. G. J. Hinde, whose accurate work on minute and obscure fossil structures, places him in the front rank of living palæontologists; Professor H. A. Miers, of Oxford, late of the British Museum; and Mr. H. B. Woodward, of the Geological Survey. Other branches of natural science are represented by Dr. F. W. Mott, the lecturer on physiology at Charing Cross Hospital and Secretary of the Neurological Society; Dr. John Murray, of the "Challenger"; the Rev. T. R. R. Stebbing, whose lively notes on Crustacea are familiar to our readers; Professor Charles Stewart, of the Royal College of Surgeons; and perhaps we may reckon Professor Karl Pearson, who occasionally strays our way from the severer realms of mathematics.

WE have alluded in our Notes and Comments to some exhibits at the Royal Society's Conversazione on May 6. Others of special interest to our readers may here be mentioned. Dr. H. Woodward showed some collections made by Dr. Forsyth Major in Madagascar, among which the remains of *Æpyornis*, also two adult human skulls said to have been found together in a cave, though far removed from one another in their degree of evolution, attracted most attention. Dr. J. W. Gregory illustrated the geology of part of British East Africa with a map, sections, specimens, and some sketches made from his notes by Mr. Hallam Murray. Mr. Henry Balfour's interesting exhibit illustrating the structure and development of the composite archer's bow, better known as "Cupid's Bow," gained considerable distinction from a unique specimen of an Assyrian bow recently found in a tomb of the 26th Dynasty, at Thebes, Egypt. The Marine Biological Association was chiefly represented by various boring marine animals, while close at hand Mr. Walter Garstang amused the passers-by with his cunning little crabs, *Atelecyclus* and *Corystes*, which burrow beneath the sand and draw in a current of water through a sieve-tube formed by the interlocking of rows of hairs on the apposed antennæ. Professor

J. B. Farmer's exhibit of nuclear division in the spores of *Fegatella conica* was chiefly interesting as showing how the processes of cell-division are governed by ordinary physical laws, as though cells had no more life than soap-bubbles. The reconstruction of models from serial microscopic sections, by the methods that have at various times been described in NATURAL SCIENCE, has been advanced a stage by Mr. Francis Dixon's device of drawing his various sections on glass plates of a thickness proportional to the magnification of the drawing and the thickness of the section; these enable one to trace the arrangement of the various internal structures, such as the nerves. The wax model of an electrical nerve-cell from the spinal cord of *Malapterurus*, made from microscopic sections in the usual manner by Dr. G. Mann, was, with its many dendritic processes, a formidable looking affair. Professor Liversidge, of Sydney, exibited specimens and photographs of the polished and etched gold-nuggets showing crystalline structure, to which we have alluded in vol. vi., p. 11. Museum authorities will doubtless be glad to have the enlarged models of the lower jaw of *Amphitherium prevosti* from the Stonesfield slate which Mr. Pycraft has made for Professor Ray Lankester. Similar models of all the unique fossil mammalian jaws in the Oxford Museum are now to be purchased.

DR. A. GÜNTHER, late keeper of the Zoological Department of the British Museum, has been elected to succeed Mr. C. B. Clarke as President of the Linnean Society, London.

FROM the report of the Geological Society, London, we learn that the index of the first fifty volumes of the Journal is now almost ready to be sent to the printers.

THE new president of the Geologists' Association, London, Mr. E. T. Newton, has initiated a quarter-hour exhibition of objects of general interest before the customary reading of papers at the evening meetings of the Association. The object of the president is not the encouragement of the bringing of indiscriminate objects to be named, but rather the exhibition and brief description of objects instructive to the whole of the members.

THE Zoological Gardens, London, have received from Mr. E. E. Austen a specimen of the Oukari monkey (*Brachyurus rubicundus*) from the Upper Amazon. The Brazilians call this the English monkey, on account of its remarkably red face. It is not the scarlet-faced Oukari mentioned by Bates in his "Naturalist on the Amazons"; for that turns out to have been *B. calvus*, living further to the east. The westward extension of *B. rubicundus* is as yet unknown, but the species of this genus appear to be confined to limited areas. Though living in high tree-tops, *Brachyurus* has a mere stump of a tail, so that it is easily distinguished from its long-tailed neighbours. It is one of the Cebidæ.

THE fine weather of last year, and various interesting additions to the Society's menagerie, had the effect of increasing the receipts of the Zoological Society, London, by £1,851 8s. 6d. as compared with 1894. A list of the animals received during the past twelve years has been prepared by Dr. Sclater, and is now in the printers' hands. The number of animals in the Gardens on December 31 last was 2,369, of which 768 were mammals, 1,267 birds, and 334 reptiles.

WE are not accustomed to look upon the unspeakable Turk as more advanced than the cute Yankee. Nevertheless, whereas the American House of Representatives has, after an animated discussion, returned the bill for the introduction of the metric system into the United States to the Committee, Turkey adopted that system on March 1 last, and has absolutely forbidden the employment of the ancient measures. The fact that the business men of Utah differ from the majority of their countrymen and unanimously agree with the Turk is not, of course, due to any subtle connection between polygamy and the ease of reckoning on a decimal system.

CORRESPONDENCE.

Is Wachsmuth and Springer's Crinoid-Monograph Published?

Are you not in error when you state, as you do in your May number (p. 359), that "Wachsmuth and Springer's Monograph of the Crinoidea Camerata of N. America will not be published before August"? You can hardly be aware that a review of the work, by Charles R. Keyes, appeared in the *American Naturalist* for April (pp. 291–295), and stated definitely that the Monograph was issued, even giving 1895 as its date of publication. S. Bergman.

[This is an interesting question. We are well aware that Mr. Keyes has reviewed the Monograph in question, not only in the *American Naturalist*, but in the *Journal of Geology*, Chicago; further, that he has in both these places, and also in the *American Geologist*, given the date as 1895, and quoted the actual number of pages and plates. Nevertheless, our statement was based on authority no less than that of the surviving author of the Monograph, and we still believe it to be correct. Mr. Bergman must get his explanation from the Editors of our above-mentioned contemporaries, for whose methods of reviewing we are not responsible.—Ed. Nat. Sci.]

A CORRECTION.

Mr. H. Hanna asks us to state that in the Editorial Note on "Preserving Fluids," on p. 294 of our May number, the words "10 per cent. solution of chromic acid" should be "1 per cent. solution," etc.

NOTICE.

To Contributors.—*All communications to be addressed to the* Editor *of* Natural Science, *at* 22 St. Andrew Street, Holborn Circus, London, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

To the Trade.—Natural Science *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

To our Subscribers and Others.—*There are now published* Eight Volumes of Natural Science. *Nos.* 1, 8, 11, 12, *and* 23 *being* out of print, *can only be supplied in the set of first Four Volumes.*

Price of set of Vols. I., II., III., IV.	£2	2 0
,, ,, ,, *V., VI., VII., VIII.*	£1	4 0
,, ,, ,, *I.–VIII.*	£3	4 0

It will shortly be necessary to raise *the price of Vols. I.–IV. still further. Nos. after* 28 *(June,* 1894) *can still be supplied at* One Shilling *each.*

Vol. VIII. ALL RIGHTS RESERVED. No. 47.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

JANUARY, 1896.

CONTENTS.

PAGE

Notes and Comments 1
Our Bengawan Fossil Ancestor—The Sanctity of Life in Africa—Dr. Donaldson Smith's Journey—The Speciesmonger in High Places—On Nomenclature: A True Word in Jest—Erratics—Glacial Geology in the North of England—A Fresh-Water Station in Norfolk—Biology in the Channel Islands—Zoology in Japan—The Cell-Theory: New Memoirs on Cells—Professor Ray Lankester—Professor Karl Pearson's Reply to Mr. Balfour—Dipterocarps—"Miscellaneous Information"—European Elephants—Bibliography of Zoology—Bibliographic Innovations.

I. The Great Avalanche on the Gemmi Pass. By Howard V. Knox. (With Plates I. and II.) 17

II. The Endeavour After Well-being. By J. Arthur Thomson, F.R.S.E. 21

III. The Constantinople Earthquake of July 10, 1894. By Charles Davison, M.A., F.G.S. (Illustrated) 27

IV. Recent Work on Seaweeds. By Annie Lorrain Smith 34

V. The Perth Museum of Natural History. By Alex. M. Rodger. (Illustrated) 41

Some New Books 46
The Fauna of British India: by W. T. Blanford.—The Royal Natural History, Birds: edited by R. Lydekker.—Handbook to the Birds of Great Britain: by R. Bowdler Sharpe.—Handbook to the Game Birds: by W. R. Ogilvie-Grant.—Structure and Life of Birds: by F. W. Headley.—Birdcraft: by Mabel Wright.—Les Oiseaux de Parcs et de Faisanderies: by R. Saint-Loup.—Les Oiseaux de Basse-Cour: by G. Cornevin.—Hawks and Owls from the Standpoint of the Farmer: by A. K. Fisher.—The Food of Woodpeckers: by F. E. L. Beal.—The Tongues of Woodpeckers: by F. A. Lucas.—The Crow Blackbirds and their Food: by F. E. L. Beal.—The Common Crow of the United States: by W. B. Barrows and E. A. Schwarz.—The Grimsby Trawl Fishery: by Ernest W. L. Holt (W. A. H.).—Catalogue of the Marine Molluscs of Japan: by H. A. Pilsbry.—Petrology for Students: by Alfred Harker.—The Elements of Botany: by Francis Darwin (A. G. T.).—Agriculture: Practical and Scientific: by James Muir.—Introduction to the Study of Zoology: by B. Lindsay.—Popular History of Animals: by Henry Scherren.—Nature's Story: by H. Farquhar.—Popular Readings in Science: by John Gall and David Robertson.—The Flowering Plants and Ferns of New South Wales: by J. H. Maiden.—Microscopical Studies in Botany: by James Hornell.

Obituary 63
H. Seebohm—G. E. Dobson—L. Rütimeyer—J. Jönsson G. Lawson—A. E. Foote—F. M. Stapff—C. Tyler—A. J. Wörtow—C. Steckelmann—E. P. L. Brock—E. L. Ragonet.

News of Universities, Museums, and Societies 66

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).

The Journal of Malacology.

AN ILLUSTRATED QUARTERLY REVIEW DEALING WITH

ALL BRANCHES OF THE STUDY OF MOLLUSCS.

EDITED BY

WILFRED MARK WEBB, F.L.S., Technical Laboratories, County of Essex, and WALTER E. COLLINGE, F.Z.S., Mason College, Birmingham,

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

LIEUT.-COL. GODWIN AUSTEN, F.R.S.; THE REV. A. H. COOKE, M.A., F.Z.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.G.S., F.R.M.S.

THE BIBLIOGRAPHY OF CURRENT LITERATURE is a Special Feature of the Magazine.

ANNUAL SUBSCRIPTION, 4s. 4d. POST FREE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood, Essex.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893) and Vol. III. (1894), Price 5s. Vol. IV. (1895) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

Latest Publications of the Zoological Society of London.

Transactions, Vol. XIII., Part XI., completing the volume, price 21/-, containing the following paper: "On the Cranial Osteology, Classification, and Phylogeny of the Dinornithidæ," by T. JEFFREY PARKER, D.Sc., F.R.S., with 7 plates.

Proceedings of the Zoological Society of London, 1895, Part 3, containing the papers read at the Scientific Meetings held in May and June, 1895, with 17 plates. Price 12/-.

The Zoological Record, Vol. XXXI., being Records of Zoological Literature relating chiefly to the year 1894. Edited (for the Zoological Society of London) by D. SHARP, M.A., F.R.S., F.Z.S., London, 1895. Price 30/-

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	*(To all places Abroad)*	
Half-Yearly	0 14 6	**Yearly**	1 10 6
Quarterly	0 7 6	**Half-Yearly**	0 15 6
		Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

ROBERT F. DAMON, WEYMOUTH.

In view of recent requirements of the

SCIENCE AND ART DEPARTMENT

in the Science Subjects of Geology and Physiography, Mr. DAMON is prepared to supply micro-slides of Rocks of all kinds for STUDENTS, including amongst many others the following :—

(a) **AQUEOUS ROCKS.**—Shelly Limestone, Oolite, Magnesian Limestone, Sandstone, Travertine, Tufa.
(b) **IGNEOUS ROCKS.**—Granite, Diorite, Syenite, Gabbro, Quartz Felsite, Obsidian, Trachyte, Dacite, Andesite, Dolerite, Basalt.
(c) **METAMORPHIC ROCKS.**—Slate, Quartzite, Crystalline Limestone, Mica Schist, Hornblende Schist, Gneiss.

Also sets of micro-slides illustrating special phenomena such as the development of crystallisation (Globulites, Trichites, Skeleton-crystals); Spherulitic structure, Shearing, Crushing, &c., &c.

PRICE:—18s. per Dozen, Packed in Boxes; or 1s. 9d. per Slide.

Address— **Robert F. DAMON, Weymouth.**

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and insectivorous Plants (50 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection. histology, and museum purposes. *Many of these are splendidly preserved in Formalin.*

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 25s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

Fauna der Gaskohle und den Kalksteine der Permformation Böhmens,

Von Prof. Dr. ANT. FRITSCH.

3 Bände, die Beschreibung und Abbildung von 101 Arten von Wirbelthieren enthaltend. 132 Tafeln in Farbendruck und 310 Textfiguren. Preis des Bandes, 128 M.

Selbstverlag in Commission von

Fr. RIVNÀČ, Prag.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The JULY and AUGUST Numbers of the PROCEEDINGS, price 1s. 6d. each, are now ready.

The July no. contains Illustrated Reports of **EXCURSIONS to the Isle of Wight, Chilworth, Betchworth, Headley, Goring, Brigstock,** and other places. The August no. contains papers on the "Geology of Co. Antrim," by A. McHenry, M.R.I.A., with folding map and many illustrations; "The Mourne Mountains," by R. Ll. Praeger, B.E., B.A. (illustrated); and on the "High-Level Drift between Hanwell and Iver," by J. Allen Brown, F.G.S. (illustrated).

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

THE

Geological Magazine:

Or MONTHLY JOURNAL OF GEOLOGY.

With which is incorporated "THE GEOLOGIST."

EDITED BY

HENRY WOODWARD, LL.D., F.R.S., Pres.G.S., F.Z.S., F.R.M.S.,
OF THE BRITISH MUSEUM OF NATURAL HISTORY;

ASSISTED BY

ROBERT ETHERIDGE, F.R.S., L. & E., F.G.S., F.C.S., &c.,
WILFRID H. HUDLESTON, M.A., F.R.S., F.G.S., F.L.S., F.C.S.,
GEORGE J. HINDE, Ph.D., V.P.G.S. &c., and
HORACE BOLINGBROKE WOODWARD, F.G.S.

1895: OCTOBER AND NOVEMBER NUMBERS NOW READY.

PUBLISHED BY

MESSRS. DULAU & CO., 37 Soho Square, London, W.

It is earnestly requested that Subscriptions may be sent to DULAU & Co., in advance. Subscribers of 18s. for the year will receive the MAGAZINE, Post free, direct on the 1st of each Month. Single copies, 1s. 6d. each.

All Communications for this Magazine should be addressed "TO THE EDITOR OF THE GEOLOGICAL MAGAZINE, 129 BEAUFORT STREET, CHELSEA, LONDON, S.W."

Books and Specimens may in future be addressed to the Editor, care of MESSRS. DULAU AND Co., 37 Soho Square, London, W.

TELEGRAPHIC ADDRESS:
"ADVERTENCE, LONDON."

TELEPHONE No. 65179.

Rait, Henderson & Co.,
LIMITED,

Artistic Letterpress - - - - and Lithographic PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. VIII. ALL RIGHTS RESERVED. No. 48.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

FEBRUARY, 1896.

CONTENTS.

PAGE

Notes and Comments 73
The Preliminary Notice—Variation of Yeast-Cells—The Nutritive Materials in Wheat Grains—Polyembryony in a Lily—The "Revue Scientifique" and Bibliography—The Bibliographic Conference—Sir Joseph Prestwich—New Literature on the Foraminifera—Australian Exploration—The Origin of Slugs—The Aptychus—The Embryology of Cirripedes and Isopods—The Sense of Rotation.

I. Lamarck and Lyell: a short way with Lamarckians. By Professor W. K. Brooks 89

II. The Pigments of Animals. Part I. By Marion I. Newbigin, B.Sc. 94

III. Foraminifera of the Chalk and of To-day. By H. W. Burrows, A.R.I.B.A., and R. Holland 101

IV. Serum Therapeutics. By F. W. Andrewes, M.D. 105

V. Casual Thoughts on Museums. Part III.—Palæontological Museums. By Sir Henry Howorth, K.C.I.E., M.P., F.R.S. 114

Some New Books 119
The Stalk-eyed Crustacea of the "Albatross": by Walter Faxon (T. R. R. Stebbing).—Cambridge Natural History, vol. v.: by Adam Sedgwick, F. G. Sinclair, and D. Sharp (G. H. Carpenter).—Descriptive Catalogue of the Spiders of Burma: by T. Thorell (O. Pickard-Cambridge).—British Birds' Nests: by R. Kearton (with plates iii. and iv.) (H. A. Macpherson).—The Climates of the Geological Past: by E. Dubois.—Open-air Studies: by G. A. J. Cole.—Introduction to the Study of Fungi: by M. C. Cooke (G. M.).—Protobasidiomyceten: by A. Möller (A. L. S.).—The Structure and Development of Mosses and Ferns: by D. H. Campbell (J. B. F.).—New Serials.

Obituary 138
H. Miller—H. M. Drummond Hay—J. B. Wilson—J. G. Morris—E. A. Wünsch—W. Thompson—M. S. Bebb—F. P. Porcher—O. v. Radoszkowski—A. P. Kosticher—P. S. Popow—Dr. Teichmann—A. von Brunn—K. B. Schiedermayr—G. Krabbe—O. Borchert—P. Galardi—A. Quadri—F. Berdau—A. de Castillo.

News of Universities, Museums, and Societies 139

Correspondence 143
William B. Clark—Edmund B. Wilson—Percy F. Kendall—E. J. Allen—H. H. Field.

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.	(*To all places Abroad*)	£ s. d.
Yearly	1 8 0	**Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6 6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893) and Vol. III. (1894), Price 5s. Vol. IV. (1895) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

Latest Publications of the Zoological Society of London.

Transactions, Vol. XIII., Part XI., completing the volume, price 21/-, containing the following paper: "On the Cranial Osteology, Classification, and Phylogeny of the Dinornithidæ," by T. JEFFREY PARKER, D.Sc., F.R.S., with 7 plates.

Proceedings of the Zoological Society of London, 1895, Part 3, containing the papers read at the Scientific Meetings held in May and June, 1895, with 17 plates. Price 12/-.

The Zoological Record, Vol. XXXI., being Records of Zoological Literature relating chiefly to the year 1894. Edited (for the Zoological Society of London) by D. SHARP, M.A., F.R.S., F.Z.S., London, 1895. Price 30/-

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

An Examination of the Present State

OF THE

Grimsby Trawl Fishery,

WITH

Special Reference to the Destruction of Immature Fish.

By E. W. L. HOLT,

Late Naturalist on the Staff of the Marine Biological Association.

"Certainly one of the most important contributions that has yet been made by the professional zoologist to the discussion of practical fishery problems."—W. A. H. in NATURAL SCIENCE.

Reprinted from the "Journal of the Marine Biological Association."

Price 1 -

May be obtained from the London Agents, Messrs. DULAU & CO., 37 Soho Square, W.; or from THE DIRECTOR, The Laboratory, Citadel Hill, Plymouth.

BRITISH MUSEUM (NATURAL HISTORY).

AN ASSISTANTSHIP of the Second Class in the Department of Zoology is NOW VACANT, the Duties being chiefly the Systematic Arrangement and Naming of some of the Groups of Insects. Limits of Age, 18 and 30 years. The Salary commences at £120 per ann.

Candidates will be required to undergo a Competitive Examination by the Civil Service Commissioners in general subjects, as well as Zoology and Comparative Anatomy. Applications, accompanied by two or three Testimonials, to be sent to the DIRECTOR, Natural History Museum, Cromwell Road, London, S.W., from whom further information can be obtained.

TYPE-WRITING, Cataloguing, Bibliography Research Work and undertaken. Authors' MS. Type-written at 1s. 3d. per 1000 words; Scientific & Technical MS at 1½d. per 72 words. Scientific work a speciality. Good References from some leading Men of Science. All orders personally attended to.—Address: Miss K. J. BUCKMAN, 20 St. Charles Square, Notting Hill, W.

ROBERT F. DAMON, WEYMOUTH.

In view of recent requirements of the

SCIENCE AND ART DEPARTMENT

in the Science Subjects of Geology and Physiography, Mr. DAMON is prepared to supply micro-slides of Rocks of all kinds for STUDENTS, including amongst many others the following :—

(a) **AQUEOUS ROCKS.**—Shelly Limestone, Oolite, Magnesian Limestone, Sandstone, Travertine, Tufa.
(b) **IGNEOUS ROCKS.**—Granite, Diorite, Syenite, Gabbro, Quartz Felsite, Obsidian, Trachyte, Dacite, Andesite, Dolerite, Basalt.
(c) **METAMORPHIC ROCKS.**—Slate, Quartzite, Crystalline Limestone, Mica Schist, Hornblende Schist, Gneiss.

Also sets of micro-slides illustrating special phenomena such as the development of crystallisation (Globulites, Trichites, Skeleton-crystals); Spherulitic structure, Shearing, Crushing, &c., &c.

PRICE:—18s. per Dozen, Packed in Boxes; or 1s. 9d. per Slide.

Address— **Robert F. DAMON, Weymouth.**

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and Insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes. *Many of these are splendidly preserved in Formalin.*

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

Fauna der Gaskohle und den Kalksteine der Permformation Böhmens,

Von Prof. Dr. ANT. FRITSCH.

3 Bände, die Beschreibung und Abbildung von 101 Arten von Wirbelthieren enthaltend. 132 Tafeln in Farbendruck und 310 Textfiguren. Preis des Bandes, 128 M.

Selbstverlag in Commission von

Fr. RIVNÀČ, Prag.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The JULY and AUGUST Numbers of the PROCEEDINGS, price 1s. 6d. each, are now ready.

The July no. contains Illustrated Reports of **EXCURSIONS to the Isle of Wight, Chilworth, Betchworth, Headley, Goring, Brigstock,** and other places. The August no. contains papers on the "Geology of Co. Antrim," by A. McHenry, M.R.I.A., with folding map and many illustrations; "The Mourne Mountains," by R. Ll. Praeger, B.E., B.A. (illustrated); and on the "High-Level Drift between Hanwell and Iver," by J. Allen Brown, F.G.S. (illustrated).

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

The Journal of Malacology.

AN ILLUSTRATED QUARTERLY REVIEW DEALING WITH

ALL BRANCHES OF THE STUDY OF MOLLUSCS.

EDITED BY

WILFRED MARK WEBB, F.L.S., Technical Laboratories, County of Essex, and
WALTER E. COLLINGE, F.Z.S., Mason College, Birmingham,

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

LIEUT.-COL. GODWIN AUSTEN, F.R.S.; THE REV. A. H. COOKE, M.A., F.Z.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.G.S., F.R.M.S.

THE BIBLIOGRAPHY OF CURRENT LITERATURE is a Special Feature of the Magazine.

ANNUAL SUBSCRIPTION, 4s. 4d. POST FREE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood, Essex.

TELEGRAPHIC ADDRESS: "ADVERTENCE, LONDON." TELEPHONE No. 65179.

Rait, Henderson & Co., LIMITED.

Artistic Letterpress - - - - and Lithographic PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. VIII. ALL RIGHTS RESERVED. No. 49.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

MARCH, 1896.

CONTENTS.

PAGE

Notes and Comments 145
The University for London—Professor Marshall Ward on "Modern Botany"—The Fertilisation of an Australian Wild-Flower—The Teaching of Marine Biology—The Association of Species—Modern Shallow-water Deposits—The Attachment of Larvæ—Fish-Culture—Preservation of Marine Mollusca—The Hinge of Bivalve Shells—Concerning Snails—The New Photography—Danish and German Science—The Giant Birds—The Kea—Dr. Charles Janet on the Hornet—The Archæology of Yucatan—The Bohemian Museum.

I. Professor Huxley: from the Point of View of a Disciple. By Professor T. Jeffery Parker, D.Sc., F.R.S. 161

II. The Natural History Departments of the Bohemian Museum. By Dr. Anton Fritsch. (With Plate V. and 3 Illustrations) 168

III. The Pigments of Animals. Part II. By Marion I. Newbigin, B Sc. 173

IV. A Rowing Indicator. By E. Cuthbert Atkinson, B.A. (Illustrated) 178

V. Dispersal of Seeds by Birds. By H. N. Ridley, M.A., F.L.S. 186

Some New Books 200
Darwin and After Darwin: by G. J. Romanes.—The Origin of Plant Structures by Self-adaptation to the Environment: by G. Henslow.—The Plants of the Bible: by G. Henslow.—A Monograph of the Land and Fresh-water Mollusca of the British Isles: by John W. Taylor (B. B. W.).—Fauna der Gaskohle und der Kalksteine der Perm-formation Böhmens: by Anton Fritsch.—The Diseases of Personality: by Th. Ribot (C. Ll. M.).—Les Cavernes et leurs Habitants: by Jules Fraipont.—Bibliographies.—Some Serials.

News of Universities, Museums, and Societies 208

Correspondence 212
W. F. Hume—H. W. Burrows and R. Holland—Adam Sedgwick—Geo. H. Carpenter.

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	*(To all places Abroad)* **Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO. Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

Vol I. (1892), Price 3s. 6d. Vol. II. (1893) and Vol. III. (1894), Price 5s. Vol. IV. (1895) will be sent in monthly parts to any address for 5s.

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, A. G. More, Rev. W. F. Johnson, R. J. Ussher, R. Warren, Dr. V. Ball, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

TYPE-WRITING, Cataloguing, Bibliography Research Work and undertaken. Authors' MS. Type-written at 1s. 3d. per 1000 words; Scientific & Technical MS at 1½d. per 72 words. Scientific work a speciality. Good References from some leading Men of Science. All orders personally attended to.—Address: Miss K. J. BUCKMAN, 20 St. Charles Square, Notting Hill, W.

WANTED.—The following numbers of NATURAL SCIENCE:

No. 8, October, 1892; No. 11, January, 1893; No. 12, February, 1893; No. 23, January, 1894.

The Publishers are prepared to give half-a-crown apiece for clean copies of the above.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A., F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready. **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 4d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood.

NOTICE.

TO CONTRIBUTORS.—*All communications to be addressed to the* EDITOR *of* NATURAL SCIENCE, *at* 22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C. *Correspondence and notes intended for any particular month should be sent in not later than the* 10*th of the preceding month.*

TO THE TRADE.—NATURAL SCIENCE *is published on the* 25*th of each month; all advertisements should be in the Publishers' hands not later than the* 20*th.*

THE "CHALLENGER" NUMBER.—*In reply to enquiries, we remind our readers that, although the* FIRST *edition of this ran out of print immediately, there are still some copies of the* SECOND *edition to be obtained at the usual price*—ONE SHILLING. *No more will now be printed, so orders should be sent at once.*

To the Directors of Museums, Universities, etc., etc.

NEW LISTS of R. F. DAMON'S celebrated Coloured Casts of Rare Fossils are now ready, and will be sent on application.

As some specimens are only made to order, to prevent disappointment early orders are respectfully requested.

Coloured copies of the magnificent and unique Reptile, *Pareiasaurus baini*, are now being supplied.

R. F. D.'s casts can be seen in very many of the Museums of France, Germany Belgium, Russia, Canada, America, Australia, India, New Zealand, etc.

—*ADDRESS*—

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Fauna der Gaskohle und den Kalksteine der Permformation Böhmens,

Von Prof. Dr. ANT. FRITSCH.

3 Bände, die Beschreibung und Abbildung von 101 Arten von Wirbelthieren enthaltend. 132 Tafeln in Farbendruck und 310 Textfiguren. Preis des Bandes, 128 M.

Selbstverlag in Commission von

Fr. RIVNÀČ, Prag.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The FEBRUARY Number of the PROCEEDINGS is now ready, containing Illustrated Papers on

"**THE NECESSITY FOR COMPETENT GEOLOGICAL SURVEYS OF GOLD MINES**," by Nicol Brown, F.G.S.

"**NOTES ON INDIAN GEOLOGY**," by W. H. Hudleston, M.A., F.R.S. (with a Coloured Geological Map of India and other illustrations).

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and Insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection. histology, and museum purposes.
Many of these are splendidly preserved in Formalin.

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

SCIENCE.

A Weekly Journal Devoted to the Advancement of Science.

EDITORIAL COMMITTEE:

S. Newcomb, Mathematics; R. S. Woodward, Mechanics; E. C. Pickering, Astronomy; T. C. Mendenhall, Physics; R. H. Thurston, Engineering; Ira Remsen, Chemistry; Joseph Le Conte, Geology; W. M. Davis, Physiography; O. C. Marsh, Paleontology; W. K. Brooks, Invertebrate Zoölogy; S. H. Scudder, Entomology; C. Hart Merriam, Vertebrate Zoölogy; N. L. Britton, Botany; Henry F. Osborn, General Biology; H. P. Bowditch, Physiology; J. S. Billings, Hygiene; J. McKeen Cattell, Psychology; Daniel G. Brinton, J. W. Powell, Anthropology.

Science holds the position in America that is held by *Nature* in England. It reports on the progress of science with special reference to the most recent work of American men of science. Science is making rapid progress in America in all directions, and in some of its departments is in advance of any other country. A knowledge of the work being accomplished is essential to all who wish to follow the progress of science, and this can be most conveniently and adequately secured with the aid of this Journal. We believe that it is almost necessary for men of science in Europe either to subscribe to Science or provide for its presence in an accessible library.

Annual Subscription, £1 0s. 6d.; Single Copies, 8d.

Address: Science, 41 East 49th Street, New York.

Printed and Published for the Proprietors by Rait, Henderson & Co., Limited, at 22 St. Andrew Street, London, E.C.

Vol. VIII. ALL RIGHTS RESERVED. No. 50.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

APRIL, 1896.

CONTENTS.

PAGE

Notes and Comments 217
Zoological Nomenclature—Zoological Nomenclature, a Proposal—The Taming of the Shrews—The Antarctic Fauna—Two Geographical Reconstructions—The Distribution of Plants—Flowers and Insects—A Poisonous Orchid—The Temperature of Plants—Technical Education in New South Wales—The Illinois State Laboratory of Natural History—The Coelomic Fluid of the Earthworm—Microbes and Butter—Diabrotica in North America—Warning Colours and Mimicry—The Embryology of Platypus.

I. The Horizontal Pendulum. By Charles Davison, M.A., F.G.S. (Illustrated) 233

II. On a Proposed Classification of the Pelecypoda. By B. B. Woodward, F.G.S., F.R.M.S. 239

III. Sharks as Ancestral Fishes, By Bashford Dean, Ph.D. (Illustrated) 245

IV. Rules of Nomenclature in Zoology. By Rev. T. R. R. Stebbing, M.A., F.L.S., and Professor E. D. Cope 254

V. The Wing of Archæopteryx. By W. P. Pycraft, M.B.O.U. (Illustrated) 261

Some New Books 267
Fishes, Living and Fossil: by Bashford Dean (A.S.W.).—A Handbook of British Lepidoptera: by E. Meyrick.—Handbuch der Paläarktischen Gross-Schmetterlinge: by M. Standfuss.—Die Artbildung und Verwandtschaft bei den Schmetterlingen, Part II.: by G. H. T. Eimer (Geo. H. Carpenter).—The Natural History of Aquatic Insects: by L. C. Miall.—Flore de l'Ile de la Reunion: by E. J. de Cordemoy.—Synoptical Flora of North America: by A. Gray and S. Watson.—Nature *versus* Natural Selection: by C. C. Coe.—New Serials.

Obituary 278
G. A. Pirona—C. Wachsmuth—Sekiya Seikei.

News of Universities, Museums, and Societies 281

Correspondence 285
E. Ray Lankester—R. I. Pocock—J. T. Cunningham—Theodore Groom—S. S. Buckman—Conway MacMillan—E. Cuthbert Atkinson.

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	(To all places Abroad) Yearly	1 10 6
Half-Yearly	0 14 6	Half-Yearly	0 15 6
Quarterly	0 7 6	Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

TYPE-WRITING, Cataloguing, Bibliography Research Work and undertaken. Authors' MS. Type-written at 1s. 3d. per 1000 words; Scientific & Technical MS at 1½d. per 72 words. Scientific work a speciality. Good References from some leading Men of Science. All orders personally attended to.—Address: Miss K. J. BUCKMAN, 20 St. Charles Square, Notting Hill, W.

TO AUTHORS OF SCIENTIFIC WORKS.—The Society of Authors is established for the maintenance and defence of literary property. It advises Members on the methods of Publishing, on the forms of their Agreements, and when necessary on the estimated cost of production. It investigates all questions of dispute connected with the above subjects and the law of Copyright. Annual Subscription—£1 1s. Terms of Membership may be had from the Secretary, G. HERBERT THRING, 4 Portugal Street, Lincoln's Inn Fields, W.C.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it is edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 6d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood

WANTED.

The following numbers of NATURAL SCIENCE:

No. 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give half-a-crown apiece for clean copies of the above-named numbers until further notice.

To the Directors of Museums, Universities, etc., etc.

NEW LISTS of R. F. DAMON'S celebrated Coloured Casts of Rare Fossils are now ready, and will be sent on application.

As some specimens are only made to order, to prevent disappointment early orders are respectfully requested.

Coloured copies of the magnificent and unique Reptile, *Pareiasaurus baini*, are now being supplied.

R. F. D.'s casts can be seen in very many of the Museums of France, Germany, Belgium, Russia, Canada, America, Australia, India, New Zealand, etc.

—*ADDRESS*—

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

All interested in Natural Science are hereby invited to subscribe to the first German periodical bearing on this subject,

ENTITLED

"NATUR & HAUS,"

An Illustrated Journal, Edited by MAX HESDORFFER *of Berlin, in collaboration with a number of the most eminent Professors of Natural Science.*

This periodical is published twice a month; each number is copiously illustrated, and contains a series of interesting essays and shorter articles dealing chiefly with following subjects:—Mammals, Birds, Amphibia, Reptiles, Horti- and Floriculture, Aquaria and Terraria, Entomology, etc. It gives the most valuable information to all Amateurs of Natural Science.

Subscription for the Year, 8s. 6d.

Specimen Copies gratis and post free on application to the Publisher—

Robert Oppenheim (Gustav Schmidt), Berlin, S.W. 46.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The FEBRUARY Number of the PROCEEDINGS is now ready, containing Illustrated Papers on

"**THE NECESSITY FOR COMPETENT GEOLOGICAL SURVEYS OF GOLD MINES**," by Nicol Brown, F.G.S.

"**NOTES ON INDIAN GEOLOGY**," by W. H. Hudleston, M.A., F.R.S. (with a Coloured Geological Map of India and other illustrations).

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and Insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes.
Many of these are splendidly preserved in Formalin.

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

SCIENCE.

A Weekly Journal Devoted to the Advancement of Science.

EDITORIAL COMMITTEE:

S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; JOSEPH LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, Invertebrate Zoölogy; S. H. SCUDDER, Entomology; C. HART MERRIAM, Vertebrate Zoölogy; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

SCIENCE holds the position in America that is held by *Nature* in England. It reports on the progress of science with special reference to the most recent work of American men of science. Science is making rapid progress in America in all directions, and in some of its departments is in advance of any other country. A knowledge of the work being accomplished is essential to all who wish to follow the progress of science, and this can be most conveniently and adequately secured with the aid of this Journal. We believe that it is almost necessary for men of science in Europe either to subscribe to SCIENCE or provide for its presence in an accessible library.

Annual Subscription, £1 0s. 6d.; Single Copies, 8d.

Address: Science, 41 East 49th Street, New York.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. VIII.
ALL RIGHTS RESERVED.
No. 51.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

MAY, 1896.

CONTENTS.

PAGE

Notes and Comments 289
Mechanical Symmetry in Living Matter—Regeneration and Involution—The Transplantation of Living Tissues—The Vestige of the Yolk-Sack—The Evolution of Adaptations—The Anatomical Society—Economic Work of the Marine Biological Association—Preserving Fluids—Phororhacos at the British Museum (Illustrated)—Prosser on Permian Problems—Gneiss, Gold, Galena, and Garnets—Alpine Flora—The Antarctic Continent—The Distribution of Earthworms—The Preliminary Notice—Priority in Nomenclature and Our Proposal—Cape Colony Geological Commission—Moving Pictures—The Edinburgh Summer Meeting—Economic Entomology.

I. "Das Tierreich" 305
II. Change in Zoological Nomenclature. By J. T. Cunningham, M.A. 309
III. A New Method in Soil-Analysis. By F. H. Perry Coste, B.Sc., F.L.S. 312
IV. Museum Work in Jamaica. By J. E. Duerden 318
V. Reproductive Selection. By Professor Karl Pearson, F.R.S. .. 321
VI. Lyell and Lamarckism: a Reply to Professor Brooks. By J. T. Cunningham, M.A. 326

Some New Books 332
Life, Letters, and Works of Louis Agassiz: by Jules Marcou (F.A.B.).—Leitfaden für Histologische Untersuchungen: by Bernard Rawitz (E. A. Minchin).—Evolution in Art: by A. C. Haddon (Henry Balfour).—Catalogue of the Fishes in the British Museum: by G. A. Boulenger (Theo. Gill).—The Skull of the Dog: by Walter E. Collinge (W.R.).—Die Gastropoden der Plankton-Expedition: by Heinrich Simroth (W.E.H.).—Text-Book of the Embryology of Invertebrates: by E. Korschelt and K. Heider; translated by E. L. Mark and W. McM. Woodworth (F.A.B.).—Faune de France: Coléoptères: by A. Acloque (D.S.).—Grundzüge der Palæontologie: by K. A. von Zittel.—De Gewervelde Dieren van het Verleden: by T. C. Winkler.—By Tangled Paths: by H. Mead Briggs.—New Serials.—Other Serials.

Obituary 352
R. E. Earll—W. Sharp—A. S. Olliff—J. Gundlach—M. P. C. Sappey—S. Hirota—M. Lawson—A. Hovelacque—G. Wagener—E. Astrup—O. Ehlers—L. Jacoby—K. Rathlef—H. Th. Wharton—H. E. Barnes—J. v. Bergenstamm—A. Schadenberg—J. Müller—F. Sansoni—R. Hay—A. L. Kennedy—T. H. Buffham.

News of Universities, Museums, and Societies 355
Correspondence 360
Henry Scherren—Recorder.

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	(*To all places Abroad*) **Yearly**	1 10 6
Half-Yearly	0 14 6	**Half-Yearly**	0 15 6
Quarterly	0 7 6	**Quarterly**	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof. A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

ALYTES OBSTETRICANS,

The Rarest European Toad.

Sent for 3/- per specimen.

Posting and package extra.

CARL HARTMANN,

LUDGERSTRASSE, 12, MÜNSTER, WESTPHALIA.

TO AUTHORS OF SCIENTIFIC WORKS.—The Society of Authors is established for the maintenance and defence of literary property. It advises Members on the methods of Publishing, on the forms of their Agreements, and when necessary on the estimated cost of production. It investigates all questions of dispute connected with the above subjects and the law of Copyright. Annual Subscription—£1 1s. Terms of Membership may be had from the Secretary, G. HERBERT THRING, 4 Portugal Street, Lincoln's Inn Fields, W.C.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 4d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood

WANTED.

The following numbers of NATURAL SCIENCE:

No. 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give half-a-crown apiece for clean copies of the above-named numbers until further notice.

To the Directors of Museums, Universities, etc., etc.

NEW LISTS of R. F. DAMON'S celebrated Coloured Casts of Rare Fossils are now ready, and will be sent on application.

As some specimens are only made to order, to prevent disappointment early orders are respectfully requested.

Coloured copies of the magnificent and unique Reptile, *Pareiasaurus baini*, are now being supplied.

R. F. D.'s casts can be seen in very many of the Museums of France, Germany, Belgium, Russia, Canada, America, Australia, India, New Zealand, etc.

—*ADDRESS*—

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

All interested in Natural Science are hereby invited to subscribe to the first German periodical bearing on this subject,

ENTITLED

"NATUR & HAUS,"

An Illustrated Journal, Edited by MAX HESDORFFER *of Berlin, in collaboration with a number of the most eminent Professors of Natural Science.*

This periodical is published twice a month; each number is copiously illustrated, and contains a series of interesting essays and shorter articles dealing chiefly with following subjects:—Mammals, Birds, Amphibia, Reptiles, Horti- and Floriculture, Aquaria and Terraria, Entomology, etc. It gives the most valuable information to all Amateurs of Natural Science.

Subscription for the Year, 8s. 6d.

Specimen Copies gratis and post free on application to the Publisher—

Robert Oppenheim (Gustav Schmidt), Berlin, S.W. 46.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The FEBRUARY Number of the PROCEEDINGS is now ready, containing Illustrated Papers on

"**THE NECESSITY FOR COMPETENT GEOLOGICAL SURVEYS OF GOLD MINES**," by Nicol Brown, F.G.S.

"**NOTES ON INDIAN GEOLOGY**," by W. H. Hudleston, M.A., F.R.S. (with a Coloured Geological Map of India and other illustrations).

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection. histology, and museum purposes.
Many of these are splendidly preserved in Formalin.

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

25th of each Month. **PRICE SIXPENCE.**

New Volume commenced with March Number.

SCIENCE-GOSSIP.

Established 1865. New Series 1894.

EDITED BY JOHN T. CARRINGTON.

"SCIENCE-GOSSIP is now one of the brightest and most diversified monthlies for the lover of science."—*Nature*, 10th January, 1895.

All Communications, remittances of Subscriptions (6s. 6d. per annum, including postage), books or instruments for review, &c., are to be addressed to John T. Carrington, 1 Northumberland Avenue, London, W.C.

TELEGRAPHIC ADDRESS: "ADVERTENCE, LONDON." TELEPHONE No. 65179.

Rait, Henderson & Co., LIMITED.

Artistic Letterpress - - - - and Lithographic PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

Vol. VIII. ALL RIGHTS RESERVED. No. 52.

NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

JUNE, 1896.

CONTENTS.

PAGE

Notes and Comments 361
Progress at the Natural History Museum—Birds and Mammals at the British Museum—*Uintacrinus* at the British Museum (Illustrated)—A New South American Mammal—Lime in Plant Chemistry—The Flora of the Soondreebun—Ehret—Australian Termitidæ—The Search for Water in Queensland—Science "Written Up"—In Post Octavo—The Liver Fluke—"Remember Mitchelstown!"—Blind Animals—The New Photography and Natural Science—Some Faunal Notes on Birds—The Chinch Bug.

I. Casual Thoughts on Museums. Part IV. The Zoological Department of the British Museum. By Sir Henry Howorth, K.C.I.E., M.P., F.R.S. 377

II. The Teeth of Fishes. By W. G. Ridewood. (Illustrated) 380

III. The Midwife Toad. By Carl Hartmann 392

IV. The Meaning of Metamorphosis. By Professor Alpheus Hyatt and J. M. Arms 395

V. Verworn's "General Physiology" 404

Some New Books 408
Catalogue of the Fossil Fishes in the British Museum: by A. Smith Woodward (Karl von Zittel).—The Growth of the Brain: by Henry H. Donaldson.—Grundriss der Krystallographie: by G. Linck.—The Structure of Man: by R. Wiedersheim; translated by H. and M. Bernard.—British Sea-Birds: by Charles Dixon (with Plate VII.).—Catalogue of the Mesozoic Plants in the Department of Geology, British Museum: by A. C. Seward.—Elements of Botany: by J. Y. Bergen.—New Serials.

News of Universities, Museums, and Societies 420

Correspondence 424
S. Bergman.—H. Hanna.

Index and Title-Page to Volume VIII.

LONDON: RAIT, HENDERSON & CO., LTD.,
22 ST. ANDREW STREET, HOLBORN CIRCUS.

PRICE ONE SHILLING NETT.
In America, Thirty Cents.
Sent Post-free for Annual Subscription of Fourteen Shillings ($3.50).
N.B.!—For Price of Sets, see Special Note on p. 424.

"NATURE,"

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE. PRICE SIXPENCE.

"NATURE" contains Original Articles on all subjects coming within the domain of Science, contributed by the most eminent scientific writers of the day. It also contains Reviews of all recent scientific works; Correspondence Columns, which form a medium of scientific discussion and of intercommunication among men of Science; Accounts of the leading Scientific Serials; Abstracts of the more valuable papers which appear in foreign journals; Reports of the Proceedings of the Principal Scientific Societies and Academies of the World; and Notes on all matters of current scientific interest.

SUBSCRIPTIONS TO "NATURE."

	£ s. d.		£ s. d.
Yearly	1 8 0	*(To all places Abroad)*	
Half-Yearly	0 14 6	**Yearly**	1 10 6
Quarterly	0 7 6	**Half-Yearly**	0 15 6
		Quarterly	0 8 0

Money Orders to be made payable to MACMILLAN & CO., Ltd.
Office: 29 Bedford Street, Strand, London.

The Naturalist:

A

Monthly Journal of Natural History

FOR THE NORTH OF ENGLAND.

EDITED BY

WM. DENISON ROEBUCK, F.L.S.,

Sunny Bank, Leeds.

WITH THE ASSISTANCE IN SPECIAL DEPARTMENTS OF

J. GILBERT BAKER, F.R.S., F.L.S.; W. EAGLE CLARKE, F.L.S., M.B.O.U.; ALFRED HARKER, M.A., F.G.S.; CHAS. P. HOBKIRK, F.L.S.; GEO. T. PORRITT, F.L.S., F.E.S.; W. B. TURNER, F.C.S., F.R.M.S.

Communications to be addressed

THE EDITORS, 'THE NATURALIST,' SUNNY BANK, LEEDS.

Single Numbers, 6d.; by post, 7d. Annual Subscription, 6/6. If paid before March 31st, 5/- post free, from the Leeds office only.

THE IRISH NATURALIST.

A Monthly Journal of General Irish Natural History.

BOTANY. ZOOLOGY. GEOLOGY.

Edited by GEO. H. CARPENTER, B.Sc., and R. LLOYD PRAEGER, B.A.

This Magazine should be in the hands of all naturalists interested in the distribution of animals and plants over the British Islands.

6d. Monthly.

Annual Subscription, *post free to any address,* **5s.**

Among the contributors are Prof. G. A. J. Cole, Prof. T. Johnson, Dr. R. F. Scharff, H. J. Groves, Rev. W. F. Johnson, R. J. Ussher, R. Warren, R. Hanitsch, Prof. W. J. Sollas, Prof A. C. Haddon, Rev. H. Friend, W. F. de V. Kane, R. I. Pocock, T. Mellard Reade.

DUBLIN: EASON & SON, 40 Lower Sackville Street (to which address subscriptions should be sent). London: Simpkin, Marshall, Hamilton, Kent & Co.

Watkins & Doncaster,

Naturalists,

36 STRAND, LONDON, W.C.

(Five doors from Charing Cross),

KEEP in stock every description of Apparatus and Cabinets of the best make for Entomologists, Ornithologists, Botanists, &c.

Our new LABEL-LIST OF BRITISH MACRO-LEPIDOPTERA, *with Latin and English Names, 1s. 6d. post free. Also other useful Label and Exchange-Lists of Lepidoptera, Birds' Eggs; useful Books on Insects, Eggs, &c.*

An Enormous Stock of British, European and Exotic Butterflies, and British Birds' Eggs, &c.

A detailed Price List sent post free on application.

ALYTES OBSTETRICANS,

"MIDWIFE TOAD."

The Rarest European Toad.

Sent for 3/- per specimen.

Posting and package extra.

CARL HARTMANN,

LUDGERISTRASSE, 12, MÜNSTER, WESTPHALIA.

TO **AUTHORS OF SCIENTIFIC WORKS.**—The Society of Authors is established for the maintenance and defence of literary property. It advises Members on the methods of Publishing, on the forms of their Agreements, and when necessary on the estimated cost of production. It investigates all questions of dispute connected with the above subjects and the law of Copyright. Annual Subscription—£1 1s. Terms of Membership may be had from the Secretary, G. HERBERT THRING, 4 Portugal Street, Lincoln's Inn Fields, W.C.

THE JOURNAL OF MALACOLOGY

An Illustrated Quarterly Review dealing with

All Branches of the Study of Molluscs,

EDITED BY

WILFRED MARK WEBB, F.L.S.,

Technical Laboratories, County of Essex,

With the assistance of THE REV. A. H. COOKE, M.A. F.Z.S.; LIEUT.-COL. GODWIN-AUSTEN, F.R.S.; CHARLES HEDLEY, F.L.S.; S. PACE; E. R. SYKES, B.A., F.Z.S.; AND B. B. WOODWARD, F.L.S., F.G.S.

The Bibliography of Current Literature is a special feature of the Magazine.

Volume IV., bound in Cloth, is now ready, **Price 5s. 6d.**

"It may be permitted us to allude to the careful way in which it edited, and the excellent manner in which it is got up."—GARDENERS' CHRONICLE.

"Well edited and beautifully printed."—GARDENING WORLD.

Other Volumes may be had in sets, price on application.

THE ANNUAL SUBSCRIPTION (4s. 6d.) IS NOW DUE.

All communications to be made to WILFRED MARK WEBB, "Holmesdale," Brentwood

WANTED.

The following numbers of NATURAL SCIENCE:

No. 8, *October*, 1892; *No.* 11, *January*, 1893; *No.* 12, *February*, 1893; *No.* 23, *January*, 1894.

The Publishers are prepared to give half-a-crown apiece for clean copies of the above-named numbers until further notice.

To the Directors of Museums, Universities, etc., etc.

NEW LISTS of R. F. DAMON'S celebrated Coloured Casts of Rare Fossils are now ready, and will be sent on application.

As some specimens are only made to order, to prevent disappointment early orders are respectfully requested.

Coloured copies of the magnificent and unique Reptile, *Pareiasaurus baini*, are now being supplied.

R. F. D.'s casts can be seen in very many of the Museums of France, Germany, Belgium, Russia, Canada, America, Australia, India, New Zealand, etc.

—ADDRESS—

ROBERT F. DAMON, WEYMOUTH, ENGLAND.

Zoological Society of London.

ZOOLOGICAL LECTURES, 1896.

A **COURSE OF TEN LECTURES** will be delivered in the LECTURE ROOM in the Society's Gardens, Regent's Park on SATURDAYS, at 4 p.m., commencing Saturday, May 2nd, by

Mr. F. E. BEDDARD, M.A., F.R.S.,

Prosector to the Society.

Fee for the Course (including admission to the Gardens on the day of Lecture), 10/-.

The Course will be free to all Fellows of the Society. Tickets for the Course may be obtained on application at the Society's Office, **No. 3 Hanover Square, W.**

No one can be admitted without a ticket.

P. L. SCLATER, *Secretary.*

Latest Publications of the Zoological Society of London.

The Proceedings of the General Meetings for Scientific Business of the Zoological Society of London for the Year 1895, illustrated by Fifty-six Plates. Price to the Fellows, 36/-; to the Public, 48/-.

Transactions, Vol. XIV., Part I., containing the following papers:—"On a Nothosaurian Reptile from the Trias of Lombardy, apparently referable to Lariosaurus," by G. A. BOULENGER, F.R.S., with one Plate. "On the Lepidosiren of Paraguay, and on the External Characters of Lepidosiren and Protopterus," by E. RAY LANKESTER, F.R.S., with one Plate. Price to the Fellows, 6/-; to the Public, 8/-.

To be obtained at the Society's Office—

3 HANOVER SQUARE, W.,

OR THROUGH ANY BOOKSELLER.

JUST PUBLISHED.

THE HORN SCIENTIFIC EXPEDITION TO CENTRAL AUSTRALIA.

To be completed in Four Parts. Part II—Zoology.

NOW READY.

4to, with 24 Plates, net £1 10s.

DULAU & CO., 37 SOHO SQUARE, LONDON, W.

On the 1st of each month, price 6d.

THE ORNITHOLOGIST:

A Monthly Magazine of Ornithology and Oölogy.

EDITED BY H. K. SWANN,

With the assistance of J. WHITAKER, F.Z.S.; O. V. APLIN, F.L.S.; F. B. WHITLOCK; Rev. H. A. MACPHERSON, M.A.; W. Hy. HEATHCOTE, F.L.S.; G. E. H. BARRETT-HAMILTON (Ireland).

We welcome this addition to the ranks of scientific journals, and hope that it may long live to encourage observation and research.—NATURE.

Contents include articles by leading ornithologists, valuable field-observations, reviews, etc. Under "Notes and News" are chronicled passing events of interest from all quarters. A high-class plate is included monthly.

SUBSCRIPTIONS (Yearly 6/-, Half-yearly 3/3) must be sent to JOHN BALE & SONS, 85-89 Great Tichfield Street, London, W.

City Agent: ELLIOT STOCK, 62 Paternoster Row,

AND ALL BOOKSELLERS.

Botany and Marine Zoology.

SPECIALITIES.

1.—**LANTERN SLIDES** for lectures and demonstrations at 9s. to 10s. per dozen.
Many photos from Nature. Latest additions are:—*Photomicrographs of Plant Sections (60 Slides). Parasitic and insectivorous Plants (46 Slides). British Marine Zoology (300 Slides).*

2.—**MICROSCOPICAL SLIDES** specially prepared for teaching purposes—quality guaranteed perfect—from 5s. per dozen.

3.—500 Types of **ZOOLOGICAL SPECIMENS** for dissection, histology, and museum purposes.
Many of these are splendidly preserved in Formalin.

Catalogues Free on Application.

Formalin.—In consequence of numerous enquiries, I have arranged for a special agency, and can supply this fluid at the extremely low price of 24s. per gallon. Smaller quantities supplied. Special quotations for large quantities.

JAS. HORNELL, Biological Station, JERSEY.

25th of each Month. **PRICE SIXPENCE.**

New Volume commenced with March Number.

SCIENCE-GOSSIP.

Established 1865. New Series 1894.

EDITED BY JOHN T. CARRINGTON.

"SCIENCE-GOSSIP is now one of the brightest and most diversified monthlies for the lover of science."—*Nature*, 10th January, 1895.

All Communications, remittances of Subscriptions (6s. 6d. per annum, including postage), books or instruments for review, &c., are to be addressed to John T. Carrington, 1 Northumberland Avenue, London, W.C.

GEOLOGISTS' ASSOCIATION.

MEETINGS are held at University College, Gower Street. For terms of Membership apply to the Secretary, C. DAVIES SHERBORN, 540 KING'S ROAD, S.W.

The MAY Number is now ready, and contains the Presidential Address—

"SOME STRUCTURAL CHARACTERISTICS OF THE GRANITE OF THE N.W. HIMALAYAS," by Lt.-Gen. C. A. McMahon. Illustrated by reproductions of Micro-Photographs.

"THE LAKE BASINS OF LAKELAND," by J. E. Marr; and short accounts of *Pleistocene Ostracoda* by F. Chapman, and *Fossil Fish* by A. Smith Woodward.

E. STANFORD, Publisher to the Association, 26 & 27 COCKSPUR ST., LONDON, S.W.

TELEGRAPHIC ADDRESS: "ADVERTENCE, LONDON." TELEPHONE No. 65179.

Rait, Henderson & Co., LIMITED.

Artistic Letterpress - - - - and Lithographic PRINTERS.

SPECIALISTS FOR

BOOK, MAGAZINE & CATALOGUE PRINTING.

ESTIMATES GIVEN PROMPTLY FOR THE FINEST WORK AT REASONABLE PRICES.

"NATURAL SCIENCE" is a Specimen of our Printing.

Also Printers of "ANNALS OF BRITISH GEOLOGY," by Professor BLAKE, M.A. &c., &c.

OFFICE AND WORKS:

22 ST. ANDREW STREET, HOLBORN CIRCUS, LONDON, E.C.

PRINTED AND PUBLISHED FOR THE PROPRIETORS BY RAIT, HENDERSON & CO., LIMITED, AT 22 ST. ANDREW STREET, LONDON, E.C.

P.

N.

for the

nnum,
ssed to

p apply

S—
E OF
repro-

ccounts

,S.W.

ED.
S.

NG.

g.
M.A.

ON,

P.